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JOHN BROWNE AND HIS TREATISE ON THE MUSCLES.[1]

By K. F. RUSSELL,
Melbourne.

JOHN BROWNE, the subject of this memoir, was a surgeon-anatomist who held the post of Surgeon in Ordinary to both Charles II and William III. He was the author of a number of books on surgery and one on anatomy; and as the latter work went through a relatively large number of editions, it is the one by which Browne is best known.

He was born in 1642 at Norwich, the birthplace of a namesake who was much more famous, the Sir Thomas Browne who wrote the "Religio Medici". Although both were acquainted with each other, they were not related.

His medical career started at Saint Thomas's Hospital, where he studied under Thomas Hollyer, and after a brief service as surgeon in the Navy, he settled at Norwich. Apparently coming under the notice of the King, he came to London in 1677 and was appointed Surgeon in Ordinary. After he had held this appointment for several years a vacancy occurred on the surgical staff of Saint Thomas's Hospital, and, armed with a letter of recommendation from His Majesty, Browne applied for the position. The governors of the hospital wished to fill the vacancy with an Edward Rice, who had given good service to the hospital during the great plague, but because of the King's letter they could not refuse Browne and he was elected on June 21, 1683. The governors' turn came, however, in 1691 when the surgeons of the hospital would not obey the regulations, and on July 7 of that year all the surgeons, including Browne, were asked to resign and others were appointed in their place.

Highly enraged over this proceeding, Browne appealed to the Lords Commissioners of the Great Seal, who called on the governors for an explanation, and when this was forthcoming, they gave a decision against Browne.

[1] Accepted for publication on July 28, 1939.

Later, in 1698, Browne made an unsuccessful attempt to be reinstated on the staff of the hospital. After the death of Charles II, Browne was appointed Surgeon in Ordinary to William III, which position he held until his death in 1700.

The following list is of his published works and the year of their appearance: 1. "A Treatise of Preternatural Tumours", London. 1678. 2. "A Complete Discourse of Wounds", London. 1678. 3. "A Treatise of all the Muscles", London. 1681. 4. "Adeno-choiradelogia: or an Anatomick-

Chirurgical Treatise of Glandules and Strumæ, or King's Evil Swellings. Together with the Royal gift of healing or Cure thereof by Contact or Imposition of Hands", London. 1684. 5. "The Surgeon's Assistant", London. 1703.

Edward Stanton
At the Saw and Crown
in Lombard Street London
LANCET-MAKER
Maketh and Sells all sorts of Surgeons
Instruments Likewise Razors, Sizors, Penknives
Knives & Forks Hones, Steams for home & foreign
Tooe Surgeons & Jesters Cases & other Cutlery wares
NB Lancets and other Instruments Carefully Ground and Sett

His treatise on the muscles first appeared in 1681, and its full title was: "Compleat Treatise of the Muscles as they appear in Humane Body, and arise in Dissection; with Diverse Anatomical Observations Not yet Discovered. Illustrated by near Forty Copper-plates Accurately Delineated and Engraven." This book was preceded in 1680 by a broadside advertisement sheet printed on August 28 entitled "Proposals for Printing a Treatise of Muscular Dissection . . . written by John Browne", and the book itself went

through the following editions, some being printed in English and some in Latin: London, 1681 (English); London, 1684 (Latin); London, 1687 (Latin); Lugduni Batovorum, 1690 (Latin); London, 1697 (English); London, 1698 (English); London, 1705 (English).

It is interesting to note that the 1687 edition was the first book ever to appear in which the names were actually printed on the muscles.

The book, one regrets to state, was not original; so few actually were in those days. The plates, indeed, were copied from a 1627 edition of Julius Casserius, but Browne had the disposition of the figures and the backgrounds altered so that the plagiarization was not too obvious. These illustrations, however, are the best part of the book, and it is doubtful if more whimsical or bizarre figures have ever graced a serious treatise on anatomy. One appears as an illustration to this memoir and shows a man standing on one leg on a pedestal very coyly demonstrating his trapezius muscle. The text is very sound and deals with each muscle in turn, describing its origin, insertion and action in the conventional manner.

Browne dedicated his work to the King and to Christopher, Duke of Albemarle, the latter dedication being couched in extremely subservient terms.

Although Browne borrowed the plates from Casserius without acknowledgement, this fact did not prevent him from obtaining a copyright issued by command of the King. This unusual and unorthodox proceeding he seemed rather proud of, for the text of the copyright appears very prominently in his book, and runs as follows:

"Charles by the Grace of God, King of England, Scotland, France and Ireland, Defender of the Faith etc. To all Our loving Subjects of what Degree, Condition, or Quality soever within Our Kingdom and Dominions Greeting: Whereas it hath been manifested unto us, that Our Trusty and Well-Beloved John Browne Esq. one of Our Chirurgeons in Ordinary, hath not only with great Art, but at the Expense of much Time and Charge, delineated, described, and accurately engraved in Copper-plates an Anatomical Treatise of Muscular Dissection; which performance of his is to Our great liking and satisfaction, so that We may express Our Approbation thereof, and give him all due and ample encouragement for the future; We do hereby signifie Our Royal Pleasure, granting unto the said John Browne the sole Proviledge of Printing the aforesaid Treatise with its Copper Figures; and strictly Charging, prohibiting, and forbidding all Our Subjects to copy or Counterfeit any the Sculptures or Description aforesaid, either in great or small, or to Import, Buy, Vend, Utter or Distribute any copies or Exemplars of the same Reprinted beyond the Seas within the term of Fifteen Years next ensuing the Date of this Our License etc."

The copy of the first edition in the collection of the writer is probably unique. It bears inside the front cover a copper-plate advertisement for a lancet-maker, one Edward Stanton at the Saw and Crown in Lombard Street, London, and dates from the period 1680 to 1700. A much reduced copy appears as an illustration.

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DENIS BROWNE SPLINTS IN THE TREATMENT OF TALIPES EQUINO-VARUS.[1]

By NORMAN M. HARRY,
Melbourne.

THE introduction of Denis Browne splints should mark the beginning of a new era in the treatment of *talipes equino-varus.*

The technique of application of the splints is not widely known in this country, and even in orthopædic hospitals overseas I have seen them applied incorrectly. In an excellent recent textbook their application is described in such a way that they would be of little value. The present account aims at outlining the principles involved in the use of Denis Browne splints and the details of a method of application which gives satisfactory results.

THE IDEAL TREATMENT OF TALIPES EQUINO-VARUS.

With *talipes equino-varus* the *os calcis* is in a position of *equino-varus* and in severe cases the heel is small. The forefoot is inverted and adducted to a variable extent and *metatarsus varus* may also be present. The tibia is internally rotated and the foot faces inward instead of being directed outward to the normal position some 20° from the sagittal plane of the body.

The ideal treatment is one which corrects all these deformities, satisfactorily maintains the correction until recurrence need not be feared, and at the same time allows physiological function of all muscles of the limb, but particularly favours the dorsiflexors of the ankle and the peronei.

The two most frequently used methods of treatment will be considered in relation to the ideal.

Repeated Manipulation and Plaster.

After mechanical correction of the deformity is obtained a padded plaster is applied from the toes either to a level below the knee or to the middle of the thigh. If the knee is not included, part of the deformity is corrected, but as there is no point of fixation away from the leg, the foot as a whole cannot be maintained in its correct relationship to the rest of the body. Wasting ensues because physiological function of the muscle is not permitted.

If the plaster is taken upward over the flexed knee, a satisfactory relationship between the foot and the sagittal plane can be maintained, the thigh acting as an essential fixed point away from the leg; but this is obtained at the expense of temporary fixation of the knee joint and the frequent development of *genu valgum.*

In short, by manipulation and repeated plasters, applied from the toes to above the flexed knee, feet affected by talipes can be maintained in a position

[1] Accepted for publication on February 13, 1939.

of "over-correction" during growth, but physiological function is not permitted.

The method therefore has an inherent fundamental defect, and similar objections can be raised against the use of adhesive strapping in attempts at the maintenance of a good position.

DENIS BROWNE SPLINTS.

Prior to use of the splint the deformity must be completely corrected by manual or mechanical manipulation. In older babies where the former is too difficult Denis Browne uses his mechanical "nutcrackers". The writer has not used them, but does not doubt their efficacy. The same result may be obtained by repeated manual manipulation under anæsthesia and the use of retentive plasters.

If the baby is a few days or weeks old, the foot may be manipulated manually into a position of *calcaneo-valgus* and a well-padded plaster applied over the flexed knee from the tips of the toes to the middle of the thigh

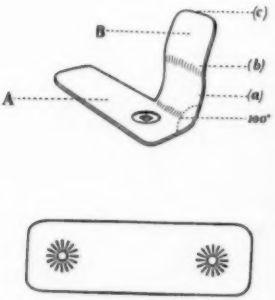

FIGURE I. Drawing of Denis Browne cross-bar and foot-piece composed of sole-plate (A) and side-piece (B).

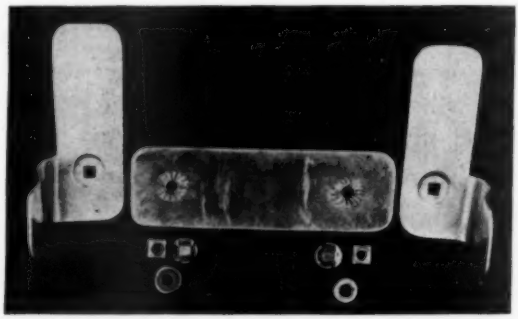

FIGURE II. Photograph of Denis Browne splints. The foot-pieces are removed from the cross-bar prior to their application.

(Figure VIII). The limb is surrounded by cotton wool applied very thickly over the internal malleolus and the inner aspect of the knee, or layers of felt are placed in these situations. The first bandages pass over the flexed knee above, down the inner side of the leg and foot, under the sole, and return to the starting point. In this way the foot is immediately fixed in the "over-corrected" position (Figure VII). Succeeding layers of plaster are applied in the same way. The cast is then completed by the application of plaster bandages in circular fashion. These cause a further tightening of the longitudinal strips and increase the *calcaneo-valgus*, but if applied too tightly they impair the circulation. If inspection shows that the toes are pale or blue, a transverse cut may be safely made in either side of the setting plaster and the degree of "over-correction" lessened until the circulation is satisfactory. In about ten days the plaster case should be removed and the splints applied. In older and resistant cases several manipulations and plaster casts are necessary preliminaries, but a period of two weeks in plaster is usually sufficient for young babies.

Description of the Splints.

The splints consist essentially of two simple yet ingeniously devised foot-pieces to which each foot is strapped separately (Figures I and II). These are then bolted to a cross-bar. In this way a point of fixation is obtained for each foot. Even when the talipes is unilateral both feet must be included, so that the attachment of the sound foot through the medium of the cross-bar is a distant point of fixation for the pathological one.

The foot-pieces are L-shaped and made of duraluminium, one-sixteenth of an inch in thickness. Dimensions suitable for babies of different ages are indicated in the accompanying table.

Table showing Dimensions of Foot-pieces suitable for Babies of Different Ages.

Age of Child.	Length of Sole-Plate in Inches.	Width of Sole-Plate in Inches.	Length of Side-Piece in Inches.
Birth	3½	1¼	2½
Six months	4½	1⅝	2¾
One year..	4¾	1¾	3

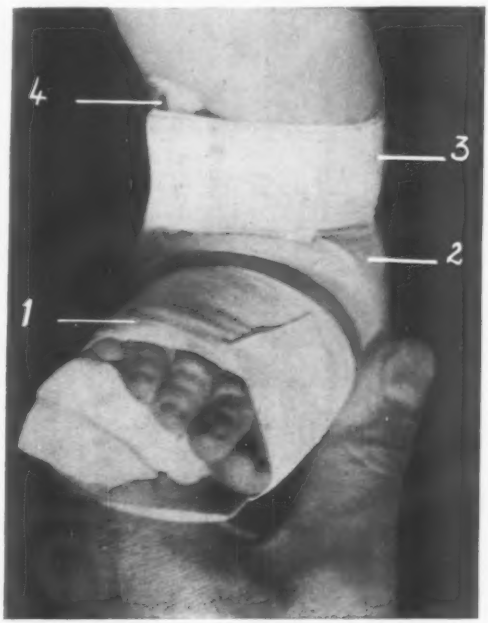

FIGURE III. Photograph of child's affected foot strapped to the foot-piece. The outer half of the foot is resting on the adhesive felt. Successive pieces of strapping have been applied (1, 2, 3). The application of (3) brings the side portion against the leg, a thin piece of felt (4) intervening. This draws the foot into further *valgus*.

The sole-plate (A) (Figure I) is flat, approximately the same length as the child's foot and a little wider. The side-piece (B) is continuous with it and is

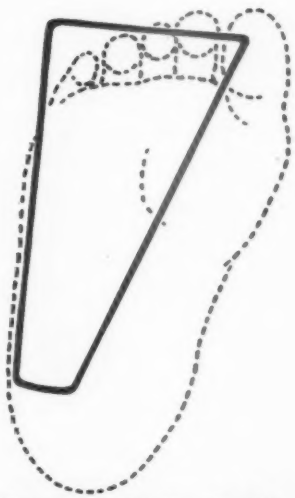

FIGURE IV. Drawing showing the site of application of bevelled pieces of adhesive felt to the under surface of the affected foot.

set at an angle of about 100° with A. This side-piece is curved outward to clear the external malleolus at (*a*); immediately above this it is curved in the opposite direction (*b*) so that the convex surface approximates to the leg, a layer of felt intervening. The free edge (*c*) is therefore well away from skin and in no danger of pressing into it.

The Application of the Foot-Piece.

Two or three pieces of adhesive felt one-third of an inch thick are cut to the following dimensions: width equal to half the diameter of the child's forefoot, and length equal to the distance between the tips of the toes and the anterior margin of the heel. With scissors each piece of felt should be bevelled off to the heel and also from the outer to the inner side. One of these pieces is then stuck to the outer half of the under surface of the foot (Figure IV).

FIGURE V. Photograph showing both feet strapped to the foot-pieces and bolted to the cross-bar. The affected right foot is fixed over two bevelled triangular pieces of felt and is therefore in *calcaneo-valgus*. The normal left foot rests on a flat rectangular-shaped piece of adhesive felt.

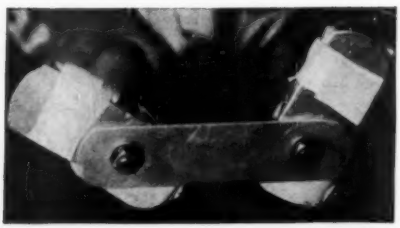

FIGURE VI. Photograph showing the splints applied. The affected right foot is bolted to the cross-bar at an angle of 70° with the sagittal plane. The normal left foot is fixed in the physiological position of 20° with that plane.

The remaining piece or pieces are applied immediately underneath. When the foot is strapped to the sole-piece the forefoot must necessarily be in *valgus* (Figure III).

The layers of adhesive felt therefore make a firm but resilient *valgus* wedge. Denis Browne realized that the method did not correct the *varus* of the heel directly, but he rightly maintained that this deformity gradually disappeared as the forefoot was kept in "over-correction" and the child was allowed to exercise its muscles.

As there is no felt under the heel, the foot is in the *calcaneus* position and, as the child kicks, extension of the knee stretches the *tendo Achillis*.

The foot is fastened to the foot-piece by means of three pieces of one inch adhesive strapping. The first (1) (Figure III) is carried across the forefoot immediately proximal to the toes and binds it to the sole-plate; usually two or three turns are sufficient. The second (2) passes over the front of the ankle and binds the heel to the plate; this is applied very firmly. The third (3) fastens the side-piece to the outer side of the leg, a thin piece of felt (4) being inserted to prevent undue pressure on the skin. The application of this third piece of strapping brings the foot into further *valgus*.

If the other foot is normal, a rectangular adhesive felt pad of even thickness is used instead of bevelled triangular pieces, and similarly strapped into position. Both foot-pieces are then bolted to the cross-bar (Figure V). The pathological foot is set at an angle of 70° with the sagittal plane of the body and the normal foot in the physiological position of 20° outward rotation (Figure VI).

Children are happy in the splints and enjoy an astonishing degree of activity. Muscular wasting is slight or absent, and joint stiffness, so commonly found in patients treated by other methods, is unknown.

The splints must be reapplied every two or three weeks. This treatment is continued for about seven months. The child by voluntary effort is usually

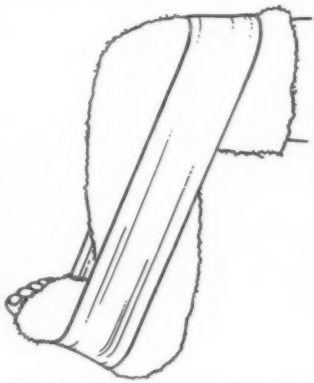

FIGURE VII. Drawing showing the first turn of a plaster bandage applied to the limb after correction of the foot deformity by manipulation. The limb is well padded with cotton wool, and additional thin pieces of felt are placed beneath this, over the internal malleolus and the inner aspect of the knee.

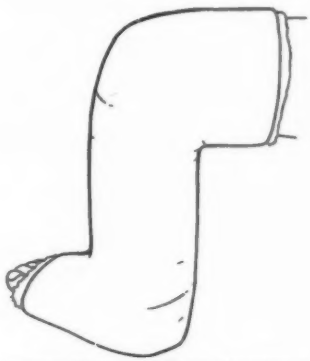

FIGURE VIII. Drawing showing a retentive plaster holding the foot in *calcaneo-valgus*. The toes are illustrated free to indicate the direction of the foot. In practice the sole portion is applied to project beyond their tips, but on the dorsum extends only as far as their bases.

able to hold the foot in *calcaneo-valgus* long before that period has elapsed, but unless special circumstances make one decide otherwise, the treatment is not terminated earlier.

As is well known, relapses can occur after any method has led to apparent cure. Prolonged treatment lessens this risk. When the splints are applied soon after the child is born, walking is not delayed, but may be possible sooner than usual.

In one instance in which the mother lived in the country and found difficulty in attending for treatment, the writer continued with the splints for five months only. As the child voluntarily held the foot in the "over-corrected" position, boots with *valgus* wedges were substituted for the foot-pieces and bolted to the cross-bar. In this way the frequency of visits was lessened and relapse did not occur. Generally speaking, however, boots should not be substituted at such an early stage. Usually treatment may be continued uninterrupted, but occasionally if the mother is careless or

neglectful, frequent soiling of the strapping with urine may cause the underlying skin to become soggy and unhealthy. In these circumstances the legs should be left free for several days only, and the mother instructed in the technique of daily manipulations. As soon as possible the splints should be reapplied.

Pressure sores are uncommon and those the writer has seen were associated with the pressure of the side portion of the foot-piece against the leg.

Twice this was caused when the surface of duraluminium became rough and flaky. Investigations showed that the metal was unnecessarily heated prior to bending. Since the recent introduction of the thin felt pad over the area of contact (4, Figure III), this complication has not arisen.

In the tropics difficulty may be experienced in getting the strapping to remain adherent. A friend, Dr. Berkeley Vaughan, of Papua, who has used the splints successfully in these circumstances states that by the application of narrow plaster bandages over the strapping he has been able to keep the foot in position.

After the termination of treatment in the splints the child is encouraged to walk in boots with *valgus* wedges.

The Denis Browne foot-pieces are removed, and boots which replace them are bolted to the cross-bar. *Metatarsus varus* is discouraged by the use of a right boot for the left foot and *vice versa*. The child is placed in these at night and when resting during the day; as the toes are allowed to project through the ends of the boots, adequate room is provided for the growing feet.

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A CONSIDERATION OF SOME PROBLEMS ASSOCIATED WITH CARCINOMA OF THE CERVIX.[1]

By L. S. KIDD,
Melbourne.

THIS paper is a consideration of several selected aspects of the position of surgery in the treatment of carcinoma of the cervix. The Commonwealth Department of Health each year issues a statistical review of the results obtained in Australia by the various methods. The only conclusion announced was that the highest percentage of so-called cures was produced by the combination of surgery with radium. Radium alone, however, was the method selected for the treatment of the greatest number of patients, in spite of the fact that the results were in some instances 30%, in others 20% and 10%, below the figures of the combined surgery and radium procedure.

A comparison of the results obtained here and in other countries is dependent upon the interpretation of the intrapelvic and vaginal conditions by the clinician at the first examination. On this interpretation depends the classification with the associated percentage of success or failure. The practical difficulties of estimating and interpreting the pathological changes in the uterus and parametrium by rectal and vaginal examination were demonstrated by Heyman, when a series of cases was submitted to several British gynæcologists for classification. Owing to the varying views concerning the type and extent of the lymphatic spread, the expressed opinions were far from unanimous.

Of operable cases in which enlarged glands are present in the broad ligaments, 57% are not malignant. Owing to complicating sepsis, they may be firm, fibrotic and surrounded by a suggestive hardness which, by palpation, is difficult to differentiate from malignant invasion. Calcified and tuberculous glands may appear in this vicinity.

In 10% of cases of carcinoma of the cervix there is an associated endometriosis of the lymph glands, and they are of stony hardness and densely adherent to surrounding structures, but they react in a pleasing way to radiation. Adler has pointed out that occasionally the adjacent glands are skipped over and the nearest metastases appear in the aortic glands.

Only when the combined method of surgery and radium is employed are there factors capable of evaluation, the exploration revealing the exact state of affairs in the pelvis. The statistics of this technique, besides being the best, are the only reliable ones because they are based on a correct interpretation after direct inspection.

When radiotherapy alone is used, an opinion should not be recorded until a retrospective interpretation has been made after the infected malignant ulceration on the *portio vaginalis* has healed, thereby permitting an estimate

[1] Accepted for publication on April 27, 1939.

to be made of the residual parametrial conditions. This is contrary to the instructions issued, but these difficult conditions are factors, apart from the actual methods of treatment, which are liable to vitiate the reliability and comparability of the statistics, and which partly account for the excessively high rates of cure claimed in some countries.

Surgery alone has no major part in the treatment of this disease. The death rate in operable cases treated by the combined method is no higher than that of hysterectomy, whereas the Wertheim operation, in the best hands, without the assistance of radium, has a mortality rate of from 10% to 18%.

In cases in which the infected cancerous ulcer has not been previously sterilized by radiation, marked hyperæmia of the extirpated glands was associated with dilated vessels and often uncontrollable capillary oozing; the glands may be large, succulent and often œdematous, dependent upon the virility of the invading microorganism, and frequent sepsis attended the interference.

The success of radium treatment depends upon a lethal dose of γ rays penetrating the whole field of invasion, as evenly as possible, from the cervix to the extreme edge of the lymphatic spread.

The radiation from vaginal implantation, as it spreads outwards, progressively decreases in intensity until the area around the hypogastric gland, at the bifurcation of the external and internal iliac arteries, receives about one-quarter to one-eighth of a carcinoma dose. Several other lines of treatment are available to rectify this deficiency. With this objective in mind, I propose to limit myself to a description of the surgery of access for the intraabdominal implantation of radon.

The abdomen is opened eight weeks after the vaginal treatment and, in suitable cases, a panhysterectomy is performed. The broad ligaments are split open and the peritoneum is lifted off the iliac vessels. The glands which are not firmly fixed are removed, but the lymphatic bed is disturbed as little as possible.

The field is now ready for the implantation of radon. On both sides of the pelvis, and along a line drawn from the open vault of the vagina to the hypogastric gland, three needles, each two centimetres in length, are placed, in tandem, with the strengths of 1·0, 1·25 and 1·5 millicuries per centimetre, the strength progressively increasing with the distance away from the position previously occupied by the cervix.

This compensates over this area for the correspondingly decreasing dose previously irradiated in the original vaginal treatment, and a suitable uniform dose along this area is secured. The needles are encased in a length of number 6 gauge black rubber tubing 25 centimetres long. The charged end lies in the desired position, whilst the other end projects through the open vault of the vagina, serving after the period of irradiation for the withdrawal of the needles; in this way no foreign bodies are left *in situ*.

When the external iliac and obturator glands are involved, a second pair of tubes containing four needles, two centimetres long and containing 1·5 millicuries per centimetre, are placed adjacent to the external iliac vessels, and the uncharged end protrudes through a stab wound in the anterior abdominal wall.

The vaginal tubes remain in position for seven days and the iliac tubes for five days.

The peritoneum of the broad ligaments is oversewn, and this makes the implantation subperitoneal. A minimum carcinoma dose is irradiated into the area where it is required.

This technique was evolved after a period of trial of five years, and I am encouraged to hope that it will prove helpful in this disease. The methods of treatment by surgery and radon are only too often a desperate endeavour to catch up with a disease that is, or almost is, out of control. The results will not be satisfactory until it is universally recognized that the earliest phases of this disease give no warning symptoms and only trivial signs.

The disease must be diagnosed by careful inspection, early biopsy and iodine testing, when it is either in the almost stationary precancerous stage or the small localized malignant plaque described by Schiller, and not by waiting for the appearance of the putrid condition generally recognized as cancer of the cervix.

THE DEVELOPMENT OF LYMPH NODES IN FAT.[1]

By E. S. J. KING,
Melbourne,

AND

PETER MACCALLUM,
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". . . she thought she would try the plan, this time, of walking in the opposite direction. It succeeded beautifully."—Lewis Carroll, "Through the Looking Glass".

AN apparent increase in the number of lymph nodes in a region where these drain an organ or tissue affected by inflammation or newgrowth is, in surgical practice, a frequently observed phenomenon. Although it is agreed by some that this is an actual new formation of the lymph nodes, others consider that minute lymph nodes merely become sufficiently large to be easily apparent. This second view is possibly the more commonly accepted hypothesis.

Examination of a considerable number of specimens removed at operation has led to the conclusion that new lymph nodes are formed and that these almost invariably (in our experience invariably) arise in fatty tissue. The evidence for this opinion is here stated. It is not intended to suggest that the enlargement of minute lymph nodes does not play some part in the production of new (macroscopic) structures, but merely to indicate that the new formation is also important.

The opinion that new lymph nodes are formed may be derived not only from everyday observations, but also from accounts given in the literature. A typical statement is that of Stiles:[8] "The number of axillary lymphatic glands which may be met with in patients suffering from cancer of the mamma is often far in excess of that usually described by anatomists." Maximow[5] states that "new foci of lymphoid tissue and even lymph nodes can develop in the adult organism". From consideration of the almost universal regenerative capabilities of tissues in the body, regeneration or new formation of lymphoid tissue is to be expected.

Since such formation has been, in our experience, confined to fat tissue and also because this is more important in surgical practice, the formation in fat tissue only is considered here. This development may be demonstrated in a number of ways which will be discussed.

We may begin therefore with the assumption that there is, on occasion, an actual increase in the number of glands.

[1] Accepted for publication on October 9, 1939.

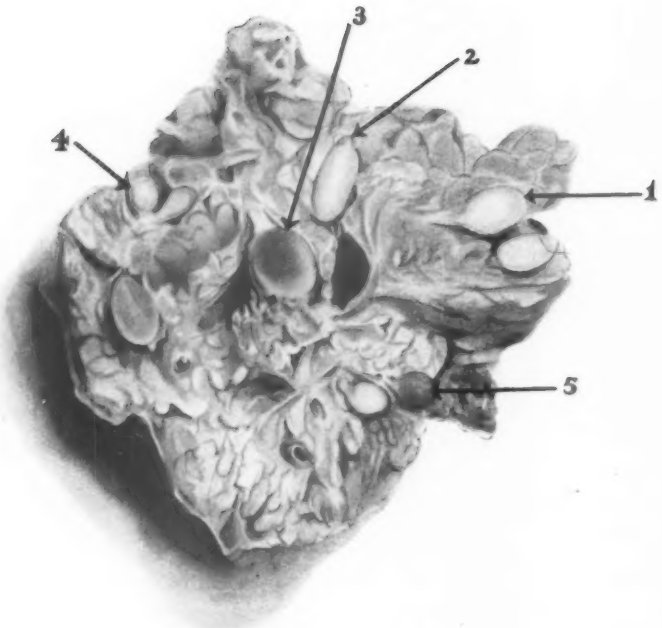


FIGURE I. Drawing of the axillary fat obtained by radical mastectomy for early carcinoma of the breast. Several large lobules have been cut across. 1 = a large fat lobule; 2 = a fat lobule with a rim of lymphoid tissue; 3 = a lymph node with some fatty tissue; 4 = a lobule consisting of lymphoid tissue peripherally and a central fat core; 5 = a typical lymph node.

RELATIONSHIP OF LYMPH NODES TO FAT.

Lymph nodes occur characteristically in those parts of the body where there is fatty tissue—the axillary and inguinal regions, the neck, mediastinum, mesentery *et cetera*. Examination of lymph nodes shows that the lymphoid tissue is closely intermingled with fat tissue. This is regarded as being due to fatty degeneration or atrophy of the lymphoid tissue, and statements to this effect are to be found in current textbooks. Again, to quote Stiles: ". . . others are frequently found to have undergone such marked adipose transformation that they are very liable to be mistaken for ordinary fat globules." A term such as "adipose transformation" is preferable to the frequently employed term "degeneration". Such transformation certainly occurs in certain circumstances.

FIGURE II. Low power photomicrograph of a "fat lobule" showing a peripheral rim of lymphoid tissue. × 8.

The reversibility of such changes, however, has been overlooked. A well recognized example showing such reversibility is the thymus. At puberty the lymphoid tissue disappears and is replaced by fibrous tissue and fat. In certain circumstances, for example, in some cases of toxic goitre, the thymus may enlarge, the fat being replaced in turn by lymphoid tissue. The fat and myeloid tissue in bone marrow and the hæmolymph glands and "brown fat" are other examples of reciprocal developments.

The acceptance of the view that a fatty transformation of lymph nodes may occur thus concedes at least the possibility of a lymphoid transformation in fat.

It is not desirable to discuss here, at any length, the problem of which of the cells in an area give rise to lymphoid cells. Examination of any material will indicate the histological difficulties which immediately arise. Two possibilities for the origin of the lymphoid cells present themselves: (i) from "endothelial" cells in the tissue, (ii) from the fat cells.

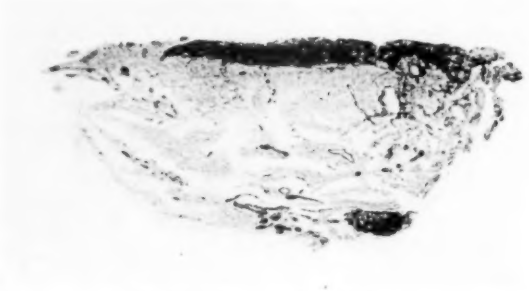


FIGURE III. Photomicrograph of a lobule showing a peripheral layer of lymphoid tissue. × 8.

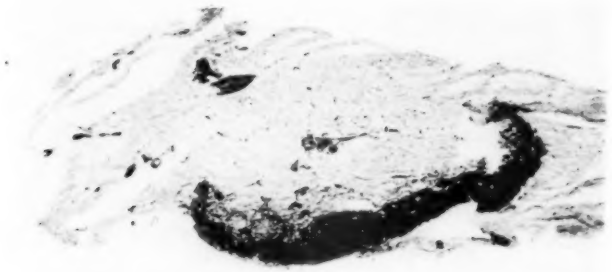


FIGURE IV. Photomicrograph of a lobule in which portion of the tissue is lymphoid. × 8.

FIGURE V. Photomicrograph of a lobule in which there is a predominance of lymphoid tissue. × 8.

It is usually stated that the former is the mode of origin. It might be noted nevertheless: (*a*) that fat cells show a considerable activity in many conditions, which will be noted by anyone making a special study of the tissue; (*b*) that fat cells are closely related to the other connective tissue, just as these are closely interrelated; and (*c*) that the fat cell is merely a mesenchymal cell which, in certain circumstances, under the action of specific stimuli, takes up fat and stores it in its protoplasm. Bayer[1] strongly advocated the fat cell origin of lymphoid tissue and considered that he had

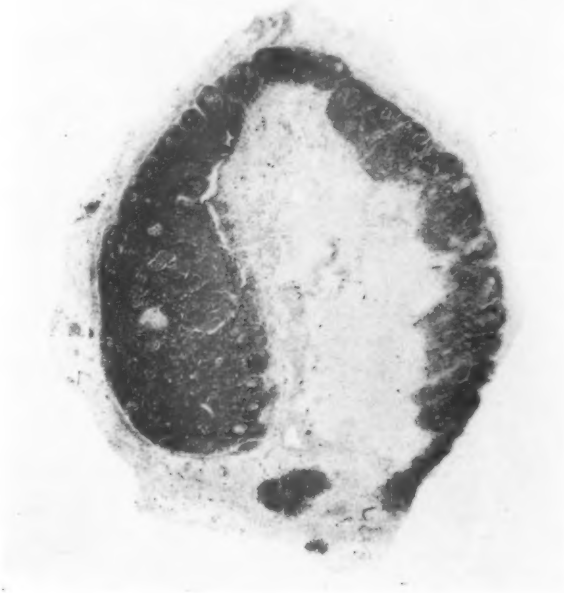


FIGURE VI. Photomicrograph of a node in which the middle part is fatty. ×8.

demonstrated this histologically. Before reading his paper we had made observations which seemed to suggest the essential importance of fat cells, but, as just mentioned, the difficulties of accurate interpretation are great.

MATERIAL.

The material examined consists of tissue obtained by block dissection of the inguinal and axillary regions in cases of malignant disease or suspected malignant disease, as well as a few examples of glandular enlargement in the submaxillary, supraclavicular, mesenteric and mediastinal regions.

In a typical example, for example, from the axilla (Figure I), the mass of fat shows a large number of lobules, which vary in size from 1·0 millimetre

up to about 2·5 centimetres (an inch) in diameter. They vary in consistency (those obviously involved by carcinoma, for the moment, being excluded) and appearance. Many of them have the characters of typical fat, but a proportion of them are firmer, have a greyish colour, are more translucent and do not show the oily quality of ordinary fat. These lobules may consist entirely of fat, but many of them contain an amount (which varies with different specimens) of lymphoid tissue. Often it is not possible to determine on gross examination how much of the lobule is actually fatty; in fact, it is not unusual to find that a nodule which was thought at first to be fat is actually lymphoid, and *vice versa*. All gradations from the fat lobule to a complete lymph node may be observed (Figures II to VI).

FIGURE VII. Photograph of a mass of fat removed from the submaxillary region. F = fat tissue; f = a large fat lobule; L = a rim of easily recognizable lymphoid tissue.

The lymphoid tissue is often found as a rim round the periphery of the lobule (Figure II), and though this may at times be apparent macroscopically (Figure VII), microscopic investigation is usually necessary to demonstrate the extent of the tissue territories. Rarely the lymphoid tissue is not peripherally situated, but is scattered throughout or is present in one portion of the lobule only. Such an appearance may be observed frequently if the lobule is sectioned obliquely instead of through the middle.

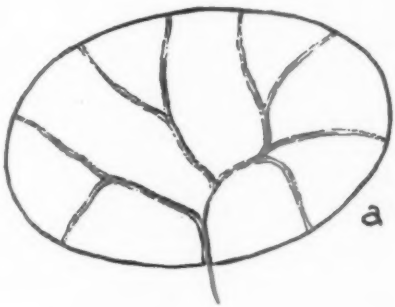
The peculiar fatty tissue described above usually occurs in association with lymphoid tissue or in lymph glands, but this association is by no means invariable. In regions where lymphatic glands do not normally occur during inflammation, the fat lobules often show the peculiar features mentioned: they are larger than usual, they have a firmer consistency (they may be observed to sink in water), and have a "gelatinous" appearance on cross-section. A lobule may be marked off definitely from its neighbours by a capsule of fibrous tissue. These lobules may be shown to possess (if the

section is made through the appropriate plane) a hilum through which blood vessels enter and lymphatic vessels leave.

The large fat lobules may be shown to be divisible into subsidiary areas by thin bands of fibrous tissue. Occasionally these areas are so loosely bound together that they are fairly obviously derived from the aggregation of smaller lobules.

Examination of the blood supply of these areas also indicates the relationship of the various forms of lobule to each other and to the lymph nodes. The small lobules are supplied by small vessels which pass round the periphery of the structure (Figure VIII). When a number of lobules become aggregated, the vessels then become incorporated in the larger lobule. The similarity, in distribution, of these vessels to those of a fully developed node is apparent (Figure IX).

FIGURE VIII. Drawing to show the vascular relationships of (A) a small fat lobule and (B) the arterioles passing between fat lobules.



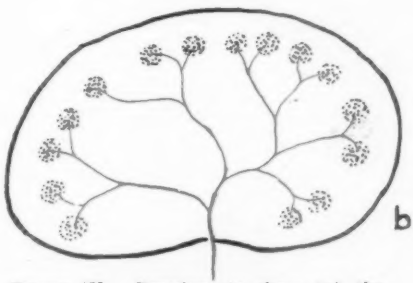


FIGURE IX. Drawings to show (a) the distribution of vessels, by way of septa, to the parts of a large fat lobule which is formed by the aggregation of a number of small lobules (compare Figure VIII)—in this way the blood vessels become incorporated within the large lobule and thus the blood vascular supply approximates to that of a lymph node; and (b) the normal vascular supply of a lymph node. The similarity of a and b is apparent.

One accidental observation seemed worthy of special note. In the wall of a gall-bladder which had been the site of chronic cholecystitis and in an area of considerable fatty deposition, a well developed lymph gland had formed. Not only was this actually in the wall of the organ (there was a

small amount of muscle external to it), but also it was near the fundus and so away from the region of the cystic lymph node (Figure X).

DISCUSSION.

The evidence for the new development of lymph nodes is of three kinds: (i) clinical study, together with gross operative findings; (ii) histological examination of pathological material; and (iii) experimental observation.

The clinical observations include the recurrence of lymphatic nodes after their removal; the increase in the number of lymph nodes in regions involved

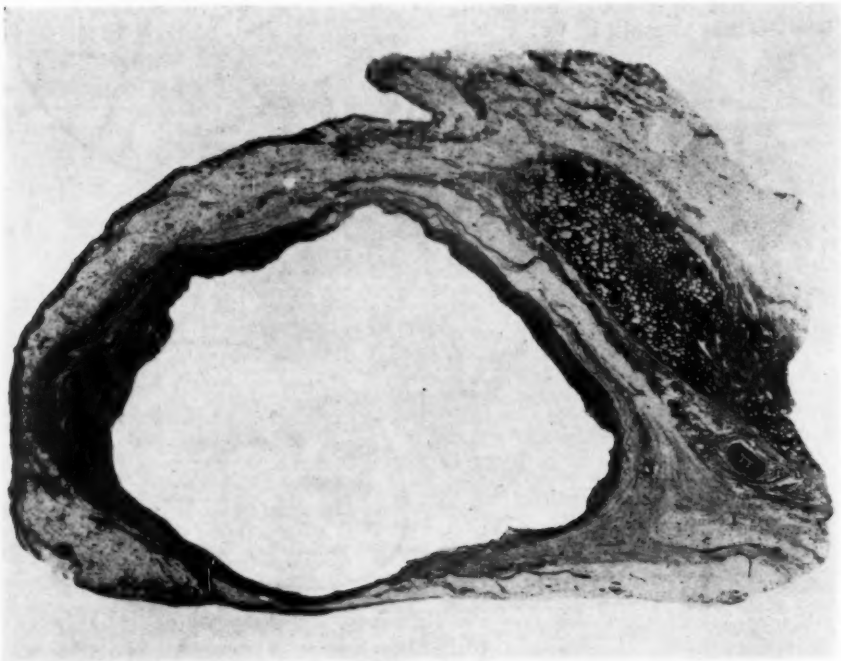


FIGURE X. Photomicrograph of a section of a gall-bladder showing a forming lymph node in the wall. × 8.

by tuberculosis, Hodgkin's disease and malignant tumours (especially carcinoma); the discovery of lymph glands in unusual situations following acute infections, as well as in pregnancy and lactation.

MacCallum[4] quotes the case of the laboratory assistant who, after having had the lymph glands of his axilla removed, developed new nodes in the subcutaneous tissue over the shoulder. Obviously such evidence is incomplete and the explanation usually given is that small lymphoid nodules have enlarged and so become apparent. These observations, however, have led to other methods of study. Histological examination of material (usually

obtained from the surgical removal of tissue containing lymph nodes) has already been referred to and illustrated.

As has been seen, all gradations between lobular fat and a complete lymph gland may be observed in one area. The conclusion that the various conditions observed indicate stages in the development of lymph nodes would not necessarily be justified if made from this alone. In some cases a single nodule which has developed under observation, is found in a mass of fat with a small amount of peripherally situated lymphoid tissue (Figure VII). Also if, in areas showing the numerous gradations, it is assumed that fatty change has occurred in lymph nodes, it necessarily follows that, since some of the masses are entirely fatty, a much greater number of lymph nodes than could reasonably be expected to be present must have been in the region originally.

Bayer[1] in 1895, from the examination of lymphangiomata, gave a number of reasons for assuming the essential relationship of fat and lymphoid tissue. All of these possibly are not germane to the problem, but others are apposite and these are discussed here. They include the observations: (*a*) that lymphatic nodes lie in fat; (*b*) that lymph nodes and fat form an entity distinct from surrounding tissues; (*c*) that there is a reciprocal relationship between fat and lymph glands; and (*d*) that definite morphological evidence of new formation may be seen. Other reasons, such as that disease of the nodes is accompanied by changes in the surrounding fat, that destruction of the lymph nodes by disease is associated with diminution of the fat, and others, are, as stated, not necessarily indicative of any tissue relationship. Zehnder,[10] whose paper appeared in 1890, observed small masses of lymphoid tissue in the neighbourhood of lymph glands and remarked on the relationship to fat tissue.

The experimental work is of two kinds: (i) the determination of regeneration in a damaged lymph node and (ii) the observation of new lymph nodes.

Regeneration is of but little importance in this discussion. Curiously there has been considerable argument on this point. For example, Delius[2] and Ribbert[9] considered that it occurred in their experimental material, and Heuter[3] and Meyer[6] came to the opposite conclusion. There is no doubt at present concerning the regenerative capabilities of most tissues, including lymphoid tissue, but the older discussions are noteworthy as indicating difficulties of observation and interpretation.

New formation may be seen (*a*) after removal of the nodes in an area, (*b*) in a new situation. The occurrence of lymph nodes in an area from which the original lymphoid structures have been removed has been observed by Ribbert and others. It is usually said that minute nodes become enlarged. Ribbert postulated this view, and indeed small microscopic lymphoid areas have been seen in the adult.

We have observed, however, the occurrence of well developed lymph nodes in the interscapular fat of the guinea-pig in some cases in which the fat had been damaged by mechanical trauma, injections of sterile water, ether *et cetera*. In a series of six dozen animals (controls) this lymphoid change was not observed and was seen in seven cases in a corresponding number of the laboratory animals. Some of the animals were investigated at an early stage (one to ten days), but no lymphoid tissue was found in these.

The evidence for the new formation of lymphoid tissue in fat therefore is obtained in a number of ways and by different methods and is strongly suggestive of a close and essential interrelationship between the two tissues.

CONCLUSIONS.

1. Lymph nodes which drain an area in which there is inflammation or newgrowth are more apparent and more numerous than in normal circumstances.

2. All gradations may be found between fat lobules and lymph nodes.

3. Lymph nodes may be found, in both experimental and clinical conditions, in situations where they are normally absent.

4. The combined evidence, clinical, histological and experimental, indicates that lymph nodes often arise in fat tissue.

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THE DIAGNOSIS, INCIDENCE AND TREATMENT OF AVITAMINOSIS *A* AND *D* IN OBSTRUCTIVE JAUNDICE.[1]

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It has been known for fifty years that the severely jaundiced patient is a poor operative risk (Mayo Robson,[1] Walters,[2] Walters and Bowler[3]). W. A. Hailes[4] has recently reported that the records of the Royal Melbourne Hospital show an operative mortality of 33% or more in cases of severe obstructive jaundice, whereas cholecystectomy in a non-jaundiced patient carries a mortality of only about 2%. The reason for this difference has long remained a mystery. Obviously exploration of the common bile duct increases the operative trauma, but this would appear to be a relatively minor factor. The solution of the problem is to be found only in a fuller study of the morbid physiology of the jaundiced patient. The great surgical importance of the subject has of late attracted many investigators. Ivy[5], in a critical review of the literature, discusses three possible ways in which biliary obstruction may exert a deleterious effect, namely:

1. Toxic action due to increased concentration in the blood of certain of the constituents of bile. There is no convincing evidence so far available to suggest that this factor is of any great importance. The excretion of these substances by the kidney may be responsible for the fact that they do not reach highly toxic concentrations.

2. Excessive pressure in the biliary passages leading to liver damage. This factor may be of considerable importance, but, as Hailes (*loco citato*) has pointed out, bile is secreted at a relatively low pressure, and the liver is therefore probably less rapidly affected by obstruction than is an organ such as the kidney which secretes at a much higher pressure.

3. The absence of bile from the intestine.

To these must be added in some cases a fourth factor, infection, which occurs as a sequel of the obstruction.

The third factor mentioned above—absence of bile from the intestine—is of great importance and can be easily corrected, as was shown by one of us (Wright[6]). Dried bile given by mouth was used in the preoperative treatment of jaundiced patients, and it was found that this led to marked symptomatic improvement and an increased absorption of fats as shown by decreased loss of fat in the stools and increased blood fat.

More recently attention has been directed to the question of absorption of the fat-soluble substance known as vitamin *K*. The importance of this substance was first recognized by Dam[7] and Almquist.[8] Quick[9] and

[1] Accepted for publication on July 23, 1940.

others have shown that this vitamin is necessary for the production of prothrombin, and that the tendency to bleed found in some cases of obstructive jaundice is due to inadequate absorption of vitamin *K*. Quick[10] has also described methods by which the prothrombin content of the blood may be conveniently estimated. Butt[11] and Stewart[12] have shown that the abnormal bleeding in jaundice can be corrected by administration of vitamin *K* together with bile salts to promote its absorption. A very full review of the whole subject is given by Hicks.[13]

Study on the absorption of the other fat-soluble vitamins *A* and *D* has been much less extensive.

It has, however, been established that night blindness, that is, delayed dark adaptation (commonly miscalled hemeralopia), is an early sign of deficiency of vitamin *A*; and it has also been shown that night blindness is present in a considerable number of cases of obstructive jaundice, but is not corrected in these cases by administration of either vitamin *A*, or carotene by itself (Altschule,[14] Greaves and Schmidt[15]).

Evidence is adduced in this paper that if bile salts are given simultaneously with vitamin *A* a great improvement in dark-adaptation time is produced.

Altschule[14] showed that infants with congenital atresia of the bile ducts showed post-mortem evidence of "*A*" deficiency, such as keratinization of the epithelium of the respiratory and renal tracts. This was found even in infants who had been fed on a diet containing abundant vitamin *A*.

Greaves and Schmidt,[15] using vaginal smears as criteria, demonstrated "*A*" deficiency in experimental obstructive jaundice in the rat, and showed further that oral administration of carotene had no effect on the condition. Seventy years ago Bamberger (quoted by Wickham Legg[16]) described night blindness and stated that all jaundiced patients in whom he found this condition had died. More recently night blindness has been described in cases of obstructive jaundice by Park,[17] Jeghers[18] and others. To complete the story, many workers, including Frandsen[19], Jeghers,[20] Eusterman and Wilbur,[21] Guilbert *et alii*,[22] have proved that night blindness is an early and constant sign of avitaminosis *A*. The explanation of this fact is to be found in the work of Wald[23][24][25] and Tansley,[26] who have demonstrated the chemical relationship between vitamin *A* and the substance known as visual purple which occurs in the rod cells of the retina.

Greaves and Schmidt[42] by calcium and phosphorus balances and Heymann[43] by blood content of vitamin *D* have shown the importance of bile for the absorption of vitamin *D*. The high value for blood phosphatase in rickets is reduced to a normal value by treatment with vitamin D, as has been shown by Bodansky,[27] Correll and Wise[28] and others. Increased serum phosphatase is also found in certain other conditions, in particular (*a*) *osteitis fibrosa cystica* and some cases of *osteitis deformans* and osteogenic sarcoma, (*b*) obstructive jaundice.

In the first group the raised phosphatase may be quite unaffected by vitamin *D* administration and is almost certainly not due to "*D*" deficiency. Thannhauser *et alii*[44] have stated that the high value for phosphatase in biliary obstruction is due to activation of the enzyme by retained bile. In this paper evidence is advanced that the raised level is in fact due to failure of absorption of vitamin *D* and thus resembles the increased

phosphatase of rickets, as distinct from that in *osteitis deformans*. A summary of the literature, with some comments on the findings of other investigators, is as follows.

Roberts[29] demonstrated the raised serum phosphatase level in rickets. Bodansky and Jaffe[27] have confirmed this observation, and have shown that with treatment by vitamin *D* the phosphatase level falls to normal. Roberts[30] found the serum phosphatase was greatly increased in obstructive jaundice, but not in other types of jaundice, and he stressed this as being of great diagnostic importance.

Rothman, Meranze and Meranze[31] and Winkelman and Schiffmann[32] confirm Roberts's findings, but the former group of authors point out that the phosphatase may be normal if the jaundice is incomplete or of short duration. Others, for example, Cantarow and Nelson,[33] are in partial disagreement and state that phosphatase estimations are unreliable in distinguishing obstructive from toxic jaundice. These workers found a normal phosphatase value in 40% of cases of obstructive jaundice, but since they give no report of investigation of the stools (the only absolute criterion of complete biliary obstruction), it may well be that the apparent discrepancy occurs because some of their patients had incomplete obstruction. Freeman, Chen and Ivy[34] showed that in animals obstruction of the common bile duct, biliary fistula or gross carbon tetrachloride poisoning may all lead to a raised phosphatase level.

Flood, Gutman and Gutman[35] report a raised serum phosphatase level in almost every case of obstructive jaundice, but mention two cases which were notable exceptions. The patients in these two instances were both infants with congenital atresia of the bile ducts, and the significance of the findings in them is discussed later.

It is thus evident that in cases of complete obstruction of the common bile duct there are signs which suggest the possibility of a failure of absorption of vitamins *A* and *D*. If the signs clear up with administration of the vitamins and bile salts by mouth, it may be reasonably concluded that they are due to inadequate absorption, in the absence of bile salts, of the respective vitamins.

This report is concerned with an investigation of night blindness and blood phosphatase in cases of biliary obstruction and the changes in these signs when vitamins *A* and *D* with bile salts were given by mouth.

METHOD.

Jaundiced patients admitted to the Royal Melbourne Hospital were examined clinically and by means of the following special tests.

Tests for Biliary Obstruction.—The urine was examined qualitatively for bile pigments by Fouchet's test[36] and for bile salts by depression of surface tension. The stools were examined for stercobilin by extraction with acid alcohol and spectroscopic examination of the extract.[37]

The quantitative Van den Bergh and the Fouchet tests were performed on the plasma in most cases and provided some additional evidence. A patient was regarded as suffering from complete biliary obstruction if the urine gave a positive response to a test for both salts and pigments, and the stools were clay coloured and showed no trace of stercobilin.

Serum Phosphatase.—The serum phosphatase level was determined on samples of venous blood by the method of King and Armstrong.[38]

Dark Adaptation.—Dark adaptation was investigated by means of a special photometer designed for the purpose. The instrument is similar in principle to the biophotometer described by Jeans[39] and the more recent instrument described by Bradley Pett,[40] but incorporates certain important new features.

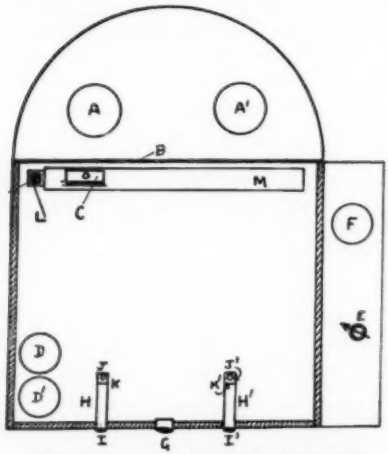

FIGURE I. Diagrammatic horizontal section of photometer; for description see text.

Description of Instrument and Test.

The apparatus (Figures I and II) consists of a light-tight box, at one end of which are two 100-watt globes (A), placed behind a sheet of ground glass (B). In front of this sheet is a source of dim light (C), comprising a small 1·5-volt globe, a colour filter to ensure monochromatic light, and two polaroid filters, one of which may be rotated, the rotation varying the intensity of light transmitted. The globe in C is supplied by a dry cell (D) and controlled by a rheostat (E). F is a milliameter included in the circuit to measure the filament current. By means of vertical (L) and horizontal slides (M), C may be moved to any desired point in the visual field, or to a point right outside the field. C is viewed through the three-diopter lens G, situated in the front of the apparatus. To the left of G is a brass tube (H) carrying a 20-diopter

FIGURE II. This shows the mounting of the apparatus and its use with a patient in bed.

lens (I) at its outer end, and at its inner end a small globe (J) just immediately behind a pin-hole aperture (K). K is placed at the focal point of the lens, that is, exactly five centimetres from it. J is supplied by a dry cell (D′) controlled by a rheostat (not shown). The distance between the lenses I and G may be adjusted to suit the interocular distance of the person being tested. H′ (with lens I′) is a duplicate of H, but situated to the right of G.

The whole apparatus is supported by a stand which allows it to be raised or lowered or rotated about a horizontal axis. It may be used to test a patient seated on a chair or, provided he can sit up, in bed. The eye to be tested is applied to G and the other eye to I or I′ as the case may be. The forehead rests comfortably against a rubber-covered support, and a hood is thrown over the head to exclude extraneous light. The patient is directed to look at J, and he is then able to observe C, some distance away, at the same time. With the visual axes of the two eyes determined by J the image of C may thus be made to fall on any predetermined point on the retina of the eye being tested. Of course, C is seen with the test eye only, and J (or J′) with the other eye, but few patients realize this, and ignorance on this point makes for a more satisfactory test. When the patient is satisfied he can look directly at J, and at the same time be clearly aware of C, the latter is removed from the visual field, and the bright light A is switched on. The patient is then seeing A with one eye and J with the other, but he is actually aware simply of a large brightly illuminated area, with a small yellow dot of light superimposed on the centre of it. This dot is, of course, due to J, and the patient must concentrate his attention on it throughout the whole test. After a period of three minutes the bright light is switched out, and C is returned to its original position. The patient can now see only the dot of light formed by J, because, although C is again in the visual field, it is invisible to an eye which has undergone three minutes' exposure to the bright light. The patient continues to look straight at J, and is told to call out as soon as he becomes aware of C. The time elapsing between switching out the bright light and the patient's becoming aware of C is recorded as the dark-adaptation time. To eliminate guessing, immediately the patient claims to have seen it, C is switched off and on, and unless he detects its disappearance the result is not accepted. In all the tests recorded below, C was kept at the same intensity (the polaroids being completely uncrossed and the filament current 150 milliampères), and always placed in the same position, namely, on the equator of the field 14° from its centre. Filter Wratten A was used in all tests.

It will be seen from the foregoing that our instrument has several important advantages over those of Jeans and Pett. First of all, the dim light used in the test may be easily varied in intensity (either by the polaroid filters or by altering the filament current), and may be placed in any desired position in the visual field. Secondly, the direction of gaze of the eye that is being tested is maintained throughout the test by the device of fixing the opposite eye on a small illuminated aperture, and lenses are used to project to infinity all the light sources which are viewed. This ensures that the visual axes are parallel and the accommodation of both eyes is relaxed throughout the test.

No attempt was made to record the light intensities in physical units because the experiment was designed to compare dark adaptation in a given patient before and after a certain form of treatment. Thus each patient provides his own standard, and elaborate measurements of millilamberts are not relevant. At the same time, provided the conditions are kept constant, the instrument can be used to compare different patients as regards their dark adaptation.

The normal adaptation time for the particular setting of the instrument was determined by testing a number of medical students and hospital out-patients. "Normal" persons showing a relatively long time were given twelve minims of "Adexolin" three times a day and retested one week later.

Jaundiced patients were tested on admission to hospital, again the next day, and later after they had been given bile salts and vitamins. The former

were given as the British Drug Houses preparation, sodium tauro-glycocholate, five grains three times a day, which contains both taurocholate and glycocholate obtained by alcoholic extraction of pig bile, but the exact proportion of each salt is unspecified. In one case (number 8) double this dose was used. This caused no harmful effects and would appear to be preferable. Some preliminary work was done, the Lilly iron bile salt preparation "Bilron" being used. This was effective, but the iron colours the stools, which is a disadvantage when these are being watched daily for signs of bile pigment. The sodium salts were therefore used in all tests. Vitamins *A* and *D* were given as the "Glaxo" product "Adexolin" in doses of twelve minims three times a day, that is, each patient received daily 30,000 international units of vitamin *A* and 5,000 international units of vitamin *D*.

RESULTS.

Dark Adaptation in Non-Jaundiced Controls.

Medical students and out-patients at the Royal Melbourne Hospital suffering from a variety of minor ailments were tested, and the results are shown in Table I.

TABLE I.

Group.	Average Age.	Age Range.	Number of Cases.	Adaptation Time.			
				Highest in Group.	Lowest in Group.	Average.	Standard Deviation.
1	19	18 to 25	42	52 seconds.	15 seconds.	32 seconds.	10·0
2	44	28 to 64	33	65 seconds.	17 seconds.	38 seconds.	14·5
3	44	28 to 64	33	40 seconds.	17 seconds.	29 seconds.	5·8

The first group comprises the medical students, whose ages ranged from eighteen to twenty-five years, and includes both men and women.

The second group comprises the hospital out-patients. The ages in this group ranged from twenty-eight to sixty-four years. Subjects whose adaptation times exceeded the somewhat arbitrary figure of forty seconds were given twelve minims of "Adexolin" daily for a week and then retested.

The cases in Group 3 are the same cases as in Group 2, but the figures obtained after "Adexolin" treatment (when this was used), have been substituted for the corresponding figures obtained before treatment.

The standard deviations quoted are admittedly not of great significance since the number of cases is comparatively small. However, it appears that forty seconds must be regarded as the upper limit of normality for persons having an adequate supply of vitamin *A*.

Dark Adaptation in Patients Suffering from Obstructive Jaundice before and after Treatment with Bile Salts and "Adexolin".

Eleven patients have been investigated, and of these four showed complete obstruction when first seen, four showed marked but incomplete obstruction, and three showed only a mild degree of obstruction. The length of history given is always open to question, since many patients are unobservant of

jaundice in themselves. A noteworthy point is that nearly all patients report noticing dark coloured urine before the jaundice appeared.

Out of the eight patients showing complete or marked obstruction of three weeks' duration or more, all had a very prolonged adaptation time. After one week of treatment the adaptation time of four returned to a normal value or to a value just above normal, the time of one became much improved but was still abnormal, and the time of two remained unimproved. One of these last two showed considerable improvement after a further week of treatment. Three patients with mild obstruction all showed adaptation times within or just above the normal range. The full details of these cases are given in Table II below.

Serum Phosphatase in Cases of Obstructive Jaundice before and after the Administration of Bile Salts and Vitamins.

The normal value for serum phosphatase given by King and Armstrong[38] is five to thirteen of the units defined by them.

Out of eleven patients with obstructive jaundice investigated seven show a value above the normal upper limit and the remaining four a high normal value.

Seven patients were reinvestigated after treatment and of these six show a very definite decrease. The remaining patient shows a small increase, probably within the limits of experimental error. There appears to be some degree of correlation between the severity of the jaundice and the phosphatase level. The details of these cases are given in Table II.

TABLE II.

No.	Sex.	Degree of Obstruction when first Seen.	Length of History. (Weeks.)	Condition.	Result of Operation.	Serum Phosphatase.		Adaptation Time.	
						Before.	After.	Before. (Secs.)	After. (Secs.)
1	F.	Complete.	3	Cholelithiasis.	Recovery.	27·0	16·1	255	45
2	M.	Complete.	3	Carcinoma of the pancreas.	Recovery.	Not estimated		285	135
3	M.	Complete.	3	Undetermined.	Death.	26·0	Died	150	Died
4	M.	Complete.	3½	Carcinoma of the pancreas.	Death.	14·0	14·2	195	45
5	F.	Marked.	4	Cholelithiasis.	Recovery.	14·0	Not repeated	>300	56
6	M.	Marked.	3½	Cholelithiasis.	Death.	14·2	5·8	>300	300
7	F.	Marked.	6½	Cholelithiasis.	Refused.	17·4	7·0	>300	>300
8	F.	Marked.	16	Enlarged glands; porta hepatis; ? nature.	Recovery.	11·1	8·6	135	70
9	M.	Mild.	5	Catarrhal jaundice.	Not operative.	15·9	8·2	30	30
10	F.	Mild.	3	Catarrhal jaundice.	Not operative.	11·3	Not repeated	29	Not repeated
11	F.	Mild.	4	Post-operative stricture of common bile duct.	Recovery.	12·0	9·2	55	56

The entry >300 means that even after 300 seconds the patient was still unable to see the dim light. The test was then stopped, but to make sure that the patient's failure was not due to his having moved his head out of position, the intensity of the light was greatly increased, and the patient then saw it immediately, but lost it again as soon as the intensity was reduced to its previous level.

Symptomatic Improvement.

All the severely jaundiced patients treated as described showed definite symptomatic improvement after a few days as indicated by their general appearance and feeling of well-being. This improvement was noticed even in patients subsequently found to have an inoperable malignant disease. Further, the patient was able to take a normal diet, whereas previously the fats had been seriously curtailed in many cases.

CONCLUSIONS AND DISCUSSION.

It is admittedly difficult to draw absolute general conclusions on the basis of eleven cases; indeed, only exceptional circumstances have justified publication at this stage. Nevertheless, the following facts are established beyond reasonable doubt.

1. Complete or nearly complete biliary obstruction leads even in a few weeks to a demonstrable increase in the dark-adaptation time and a high value of the serum phosphatase.

2. Treatment with bile salts, even in small doses, together with vitamins *A* and *D*, leads to marked symptomatic improvement and a return to more normal dark-adaptation and phosphatase values.

There is abundant evidence that the dark-adaptation time is a reliable index of vitamin *A* deficiency. Definite improvement follows administration of this vitamin together with bile salts in cases of obstructive jaundice. The importance of using bile salts is suggested by purely theoretical considerations, and is confirmed by the fact that previous workers, using vitamin *A* without bile, were unable to produce results comparable with those we have found.

The time taken to produce marked improvement (one week in most cases) may appear rather long; and possibly this could be reduced by the use of larger doses of bile.

There is evidence of a very mild degree of vitamin *A* deficiency in some of the non-jaundiced patients; this responded readily to vitamin therapy without the use of bile salts.

The significance of the phosphatase values is not so easily assessed. An increased serum phosphatase does occur in conditions of vitamin *D* deficiency (for example, rickets), but it may also occur in quite other circumstances (for example, generalized *osteitis fibrosa cystica*, and some cases of *osteitis deformans* and osteogenic sarcoma). In the former case vitamin *D* therapy leads to a gradual return to normal of the phosphatase, and we have shown that this also happens in obstructive jaundice, provided bile is given also to promote absorption of the vitamin. In *osteitis deformans*, on the other hand, administration of vitamin *D* is without effect on the phosphatase (Roberts[29]). It therefore seems reasonable to conclude that, whatever may be the significance of the raised phosphatase level in this latter condition, in obstructive jaundice, as in rickets, it is a direct consequence of the vitamin *D* deficiency. This hypothesis also affords a ready explanation of the findings of certain other workers. Thus patients suffering from hæmolytic or other non-obstructive jaundice show a normal serum phosphatase level because they have no lack of bile in the bowel. In cases of bile fistula the same effects are seen as in cases of obstruction. The cases of obstructive jaundice described by Cantarow and Nelson[33] showing a normal serum

phosphatase level were possibly examples of incomplete obstruction, since the stools were apparently not adequately examined by these workers.

Regarding the infants with congenital atresia of the bile ducts described by Flood, Gutman and Gutman,[35] the most probable explanation is that the maternal provision of vitamin *D* was not exhausted; that this was the case is suggested by the fact (whose possible significance appears to have escaped the observers) that the younger infant (aged one month) showed only 6·3 Bodansky units of phosphatase, whereas the older (aged two months) showed 11·1 units, which is close to the upper limit of normality.

It is thus evident that gross biliary obstruction leads to deficient absorption of the fat-soluble vitamins *A* and *D*, and it is demonstrated that this deficiency can be corrected by the administration of bile salts and vitamin concentrates by mouth.

Others have shown that vitamin *K* is badly absorbed in obstructive jaundice, that this deficiency is responsible for the abnormal bleeding sometimes found in these cases and that it may be corrected in like manner to the others.

If pancreatic secretion, as well as hepatic, is prevented from entering the duodenum, there is very imperfect splitting of fats, and it seems highly probable in these circumstances that, despite bile salt administration, fat-soluble vitamins would be largely excreted in the stools in solution in the unsplit fat.

Recently Montgomery *et alii*[41] have investigated the effect of orally administered pancreatic juice on lipoid metabolism in depancreatized dogs, and their results raise the question of the possible clinical value of giving pancreatic juice by mouth in cases in which examination of the stools reveals an excessive amount of unsplit fat. Further work on this point is to be undertaken.

These facts appear to be of great surgical importance. The operative mortality among severely jaundiced patients is high. These patients frequently show a demonstrable vitamin deficiency, the correction of which is accompanied by marked symptomatic improvement. It therefore appears to be the duty of the surgeon to correct this deficiency before subjecting any patient with obstructive jaundice to laparotomy. To achieve this the patient must have a full diet, supplemented at first by extra vitamin in concentrated form, together with bile salts in adequate dosage, for the duration of the obstruction.

SUMMARY.

A new photometer for the measurement of dark-adaptation time is described. By its means a prolonged adaptation time has been demonstrated in cases of obstructive jaundice, and evidence is given that this finding is an indication of deficient absorption of vitamin *A*.

The serum phosphatase is raised in cases of biliary obstruction and reasons are given for the belief that this is an indication of deficient absorption of vitamin *D* in such cases.

The observation of other workers that vitamin *K* also is deficiently absorbed by the jaundiced patient is discussed, and the method of correcting these various deficiencies by the oral administration of bile salts and vitamin concentrates is described. The importance of applying this method in the preoperative treatment of patients suffering from obstructive jaundice is indicated.

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PERFORATION OF THE SMALL INTESTINE[1] BY SWALLOWED FOREIGN BODIES.[2]

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Perforation of the small intestine or of Meckel's diverticulum by a foreign body that has been swallowed is an unusual but not a rare condition. Any surgeon is likely to encounter a case at any time, but such encounters will be uncommon.

The majority of ingested foreign bodies pass naturally; a number of them are removed from the œsophagus or elsewhere; a very small proportion will perforate the gut. Concerning the last-mentioned, the following statements represent the consensus of opinion of writers on the subject.

1. Perforation of the small gut is less common than perforation of the large gut. Clinically, the former tends to result in an acute peritonitis, the latter in a localized intraabdominal abscess without acute manifestations.

2. Perforation of Meckel's diverticulum occurs, but is rare. However, persistence of this diverticulum is not common and one gets the impression, by taking this factor into consideration, that perforation of the diverticulum, in comparison with perforation of the ileum, is not as rare as has been made out by some writers.

3. The vermiform appendix is involved less frequently than might be supposed.

4. Ischio-rectal abscess, as a result of an anal perforation by a foreign body, is well known.

It is obvious, from a study of the literature, that the correct clinical diagnosis of perforation of the small intestine by an ingested foreign body has rarely, if ever, been made in those cases first seen after perforation has occurred. This paper represents, in part, an endeavour to point out certain features common to all cases, which may be of assistance in the diagnosis of the condition.

Case Reports.

Five cases of perforation of the small intestine and one of perforation of Meckel's diverticulum by an ingested foreign body are herewith reported. In three of these six cases operation was performed by the writer when on the emergency surgical service at the Alfred Hospital, Melbourne. An examination of the hospital records of the past six years produced two further cases; in one of these Meckel's diverticulum was involved. The sixth patient was under the care of Dr. K. E. Rex and Mr. C. A. M. Renou, who kindly supplied the details which follow. In all, except as mentioned above, the terminal part of the ileum was the site of the perforation.

[1] Not including the duodenum.

[2] Accepted for publication on April 26, 1940.

The Author's Cases.

CASE I.—A stout female, sixty-eight years of age, was admitted to the Alfred Hospital on September 2, 1937. A burning, lower abdominal pain had commenced two days before and had recently moved to the right iliac fossa. Her bowels had not acted since the onset of the illness. There had been no nausea or vomiting, no anorexia, and there were no urinary symptoms. Ten years previously her gall-bladder had been removed.

On admission her temperature was 97·8° F., her pulse rate 80. The abdomen was lax, but there was rigidity in the right iliac fossa. Tenderness was complained of in this region. No mass or viscus was palpated. There was a firmly healed scar in the right upper part of the abdomen. A diagnosis of acute appendicitis was made.

The abdomen was opened through a right muscle-splitting incision. The appendix was thickly covered with fibrin and lay in a pool of turbid fluid. It was delivered and removed. The stump was crushed, ligated and invaginated into the caecum. While this was being done, a small foreign body was detected, projecting from the wall of the ileum, half an inch from the ileo-caecal junction. It was extracted. No opening could be found, so a small piece of omentum was sewn over the area. The pelvis was drained by a piece of Penrose drain brought out through the wound. The subcutaneous tissue was also drained. Both drains were removed in twenty-four hours. The foreign body was a bristle, one inch in length. The mucosa of the appendix was not involved in the inflammatory process. Recovery was uneventful.

CASE II.—A male, fiftv-two years of age, was admitted to the hospital on June 13, 1938. His illness commenced sixty hours before with the gradual onset of generalized griping abdominal pains. These had persisted intermittently ever since, gradually increasing in severity. He had vomited many times in the first thirty hours, but only once in the previous thirty hours. He had eaten nothing since the commencement of his illness. There were no urinary symptoms and no symptoms of dyspepsia. His temperature was 99° F., his pulse rate 96.

The abdomen was distended and movement was restricted. Tenderness and rigidity were present over the whole lower part of the abdomen, greatest somewhat on the right side. Rectal examination revealed peritoneal tenderness, maximal on the right side. A diagnosis of acute obstructive appendicitis with diffuse peritonitis was made, although the persistence of the severe colic after peritonitis had developed caused this diagnosis to be put forward only tentatively. The abdomen was opened through a right muscle-splitting incision. Free purulent fluid was present in the peritoneal cavity. The appendix was delivered, but obviously was not the cause of the peritonitis. It was removed in the usual way. On further exploration a sharp point could be felt projecting from the ileum approximately one foot from the ileo-caecal junction. The loop of gut was delivered; it was reddened, distended and covered with fine stringy fibrin. A second perforation was found nearer the caecum. A bone was withdrawn and the resulting laceration was oversewn. The second perforation was dealt with in the same way. The wound was closed without drainage of the peritoneal cavity, but with drainage of the subcutaneous tissues. The abdomen was distended for a few days and an infection of the wound developed. The patient recovered and was discharged on July 3, 1938.

The bone was a flake of sheep's tibia, triangular in shape, one and a quarter inches in length, with a base slightly under half an inch in width. One edge and the point were exceedingly sharp. The patient could not remember having swallowed it.

CASE III.—A male, forty-one years of age, was admitted to the hospital on Christmas night, 1938. His symptoms had commenced five hours before, with the onset of severe pain in the suprapubic region. The pain soon spread over the whole abdomen; it was of an intermittent colicky nature with a burning residual pain between the spasms. There was no vomiting or nausea. There were no urinary symptoms, and there had been no previous dyspepsia. His temperature was 98·6° F., his pulse rate 90.

On examination the whole abdomen was very tender and rigid, but both these features were most marked in the lower part of the abdomen, where the rigidity was so extreme as to be described as board-like. No sound could be heard on auscultation. There was slight tenderness on rectal examination. The clinical picture was definitely unlike that seen with an acute appendicitis. Points of resemblance to Case II led to the making of a diagnosis of peritonitis, probably due to perforation of the ileum by a foreign body.

The abdomen was opened through a right lower paramedian incision. There was much thin pus in the pelvis, surrounding coils of reddened small intestine. On insertion of a hand a foreign body could be felt in a loop of ileum which was lying in the pelvis. The loop was withdrawn and the tip of the foreign body could be seen projecting through its wall, approximately ten inches from the ileo-caecal junction. There was a second perforation close by. The foreign body was extracted and each perforation was infolded. The abdomen was closed without drainage. The abdomen was distended for a few days, but the patient made a good recovery.

The foreign body was a slightly curved piece of turkey rib, approximately one and a half inches in length, with a very sharp jagged point. The patient could not remember having swallowed it, although it is a fair assumption to conclude that it formed part of his Christmas dinner.

The Cases from the Alfred Hospital Records.

CASE A.—A male, thirty-eight years of age, was admitted to the hospital on May 16, 1935. His symptoms had been present for seventy-two hours. They commenced with a fairly severe pain in the suprapubic region. It was of a dull dragging nature and forced the patient to lie still. Twenty-four hours before his admission to hospital the pain shifted slightly to the right lower part of the abdomen, although it was still present in the lower and middle part of the abdomen and apparently much worse there than on the right side. Anorexia was present, but no vomiting. His bowels had not acted since the onset of his illness. The temperature was 100·4° F., the pulse rate 88. On examination the abdomen generally was soft and flaccid, but there was some rigidity of the right lower quadrant. Tenderness was present in the lower part of the right side of the abdomen and was maximal slightly to the right of the mid-line. No mass or viscus was palpated.

The abdomen was opened through a right muscle-splitting incision. Free fluid was present. The appendix was long and injected, but otherwise normal. A large abscess was discovered in the omentum. It was excised *en bloc* and the bleeding points were ligated. A fish bone was found to be projecting from the small intestine and lying in the abscess. The appendix was removed and the wound closed without drainage. The patient recovered after a disturbed convalescence due to distension and wound infection.

CASE B.—A female, thirty-one years of age, was admitted to the hospital on February 11, 1939, a provisional diagnosis of acute appendicitis having been made. Her symptoms were of two days' duration. Pains had commenced in the right side of the abdomen and extended down to the groin; they doubled her up and made her sweat. The pains eased, only to recommence six hours later. They were now more severe and spasmodic. She vomited once. There were no urinary or menstrual symptoms. Her bowels were costive. On examination the abdomen was lax. There was some slight rigidity of the right lower quadrant. Tenderness was present in the right loin and in the right lower quadrant. No mass was felt. *Per vaginam* there was tenderness in the right fornix. For three days she was treated expectantly, but her condition did not improve. On the fourth day the abdomen was explored through a right muscle-splitting incision. A Meckel's diverticulum was found, acutely inflamed, with a bristle protruding near its tip. The diverticulum was removed, as was the appendix. A normal convalescence followed.

A third case, which has not been included in the review, is herewith described briefly.

A congenitally mentally deficient patient was admitted to the hospital on October 18, 1937, in a moribund condition. No history was obtained. He died shortly afterwards. The autopsy revealed a purulent peritonitis. The lower end of the jejunum was perforated. The perforation was seven millimetres in diameter, and there was no evidence of a pre-existing ulcer. No foreign body was found, but the stomach and intestines contained large numbers of unchewed haricot beans. It was presumed, perhaps erroneously, that the perforation was due to one of these beans.

REX'S CASE.—A female, forty-eight years of age, complained of generalized abdominal pains which had commenced three weeks before, soon after she had attempted to push a motor car. The onset of the pain was gradual; the pains were persistent,

but never severe. They were present mainly in the lower part of the abdomen. She had nausea and anorexia, but no vomiting. One week before she consulted Dr. Rex, she had had a somewhat more severe pain, which had lasted ever since. She had taken castor oil to obtain relief. The bowels acted, but the pain became worse. On examination her temperature was 98·4° F., her pulse rate 64. Abdominal examination revealed signs of general peritonitis with maximum tenderness in the right lower quadrant. There was an indefinite thickening deep in the right iliac fossa—probably a mass. Rectal examination revealed great tenderness, especially on the right side.

Operation was performed by Mr. Renou. Because of the indefinite clinical picture the abdomen was opened through a right lower paramedian incision. A large inflammatory mass was identified in the right iliac fossa. The omentum was separated from this and a wooden toothpick, approximately two and a half inches in length, was found. It had perforated the lower part of the ileum in two places. The perforations were oversewn, the pelvis was drained and the wound closed. The patient recovered after a stormy convalescence.

A REVIEW OF THE LITERATURE.

The literature concerning this subject is not extensive. Several well-known systems of surgery fail to mention the condition.

C. and C. L. Jackson authoritatively discuss the whole problem of inhaled and ingested foreign bodies, but in reference to small-gut perforations they approach the subject from the aspect of the foreign body known to have been swallowed, rather than from the aspect of the clinical problem after perforation has occurred. Most of the foreign bodies so described are of metal.

A. H. M. Siddons collected from three London hospitals 126 cases in which foreign bodies were known to have been swallowed; amongst these three perforations occurred. No detailed descriptions are given, but it seems apparent that these foreign bodies also were made of metal.

Ginzberg and Beller give an excellent account, with a number of illustrative cases, of perforations throughout the whole gut by non-metallic foreign bodies. They describe two perforations occurring in small intestine in hernial sacs, and one very typical perforation of the terminal part of the ileum.

Apart from these reviews, those cases of perforation of the small intestine by swallowed foreign bodies appearing in the literature are for the most part isolated examples of the condition. In the past twelve years, nine such cases have been described in the English language. These, together with the six cases reported above, form the basis for this article. Perforations of Meckel's diverticulum have been included because of the anatomical and clinical relationships involved. The duodenum, however, has not been considered.

Site of Perforation.

The terminal part of the ileum is by far the portion of the small intestine most commonly involved. Of fifteen perforations no less than eleven were of the ileum; three were perforations of Meckel's diverticulum and but one was a perforation of the jejunum. Anatomical characteristics of the gut undoubtedly account for the greater likelihood of the ileum to be injured.

Character of the Foreign Body.

Bones from poultry, fish and meat, pieces of wire, a prune seed, pieces of wood and a porcupine quill are included in the list of foreign bodies removed at operation.

Ginzberg and Beller have classified swallowed foreign bodies as metallic and non-metallic. They point out that a very definite clinical difference usually exists between the symptoms that they cause. In a typical case in the former group the whole episode is dramatic, the accident is noted immediately, the patient is rushed to a physician and is under medical care from the beginning. Perforation is uncommon in these cases. In the latter group, on the other hand, the physician is first consulted because of symptoms after perforation has occurred. The patient is found to have forgotten, even if he ever noticed, that he swallowed anything unusual.

Siddons divides the foreign bodies in his series into (*a*) blunt objects, which, apart from obstruction, usually do no harm; (*b*) long blunt objects, which may impact and perforate the wall of the gut by ulcerating slowly through it; and (*c*) sharp objects, which may perforate the gut rapidly.

A study of the cases reviewed confirms the opinions expressed above; nearly all were instances of perforation by a sharp object and very few of the patients were able to recollect having swallowed such an object, even when shown it after operation. Concerning this observation, it must be stated that not one of these cases was of the first clinical variety described by Ginzberg and Beller, and, whether the foreign body was of a metallic or a non-metallic nature, each case fell into the second clinical group, in which medical advice is sought after perforation has occurred. This suggests that most non-metallic and some metallic foreign bodies are ingested in the act of eating, when their presence conceivably might be undetected in a mouthful of food. Many of the foreign bodies in the series obviously could be included accidentally in food during the preparation of a meal, although their size does not reflect very favourably on the eating habits of the patients. The man who came to surgery on Christmas night, his ileum perforated by a turkey bone, had eaten Christmas dinner earlier that day and did not notice that he swallowed anything unusual.

The conclusions the writer has reached in connexion with this part of the discussion are that the foreign bodies can be ingested: (*a*) at meals—the foreign bodies are usually but not always of a non-metallic nature and the patients usually adults with hearty appetites; (*b*) apart from meals—the foreign bodies are usually of a metallic nature and the patients usually children at play. The former group includes most of the cases under review.

Difficulties in Diagnosis.

It is again pointed out that each one of the patients in this series was seen first after perforation had occurred. The difficulty experienced in diagnosing the actual condition is stressed by the majority of the writers. The clinical picture that results is often very confusing. Peritonitis is present to a greater or a lesser extent, but the cause of the peritonitis is difficult to determine. A number of cases are diagnosed as appendicitis; in others the diagnosis is regarded as obscure. The perforation in the gut may be small, as from the prick of a fine fish bone, or it may be comparatively large, as in Gaither's case from the erosion of a prune seed. Further, it may occur slowly or it may occur rapidly. Consequently the inflammatory reaction of the peritoneum may be localized or it may be diffuse. In addition, the omentum may seal off the inflammatory process and the extruded part of the foreign body, particularly when the foreign body is small or when the perforation occurs slowly. Usually the history is of short duration, but in

a few reports mention is made of the presence of abnormal abdominal symptoms for a considerable period, even months, before the patient sought medical advice. These pathological and clinical variations, no doubt, account for the difficulties that have been experienced in the diagnosis of this condition. Another important factor, perhaps, is the rarity of such cases in any one surgeon's experience.

Gross Pathology.

Ginzberg and Beller describe the pathological sequence as follows:

> The first effect of the arrest of the foreign body is an abrasion of the mucosa with the formation of a small ulcer. A continuation of the pressure results in an area of necrosis, progressively involving the different layers of the intestinal wall. Through this breach intestinal organisms pass, giving rise to a local peritonitic reaction, even before actual perforation has occurred. . . . When actual perforation does occur the response varies with its rate. If rapid, a diffuse peritoneal exudate or localised abscess results. The slowly perforating types, on the other hand, incite a reaction which is mainly productive, an inflammatory granulation tissue resulting, which may contain pin point abscesses.

At operation one of two conditions is found to have occurred. The first of these is rapid perforation. Free fluid is present in the peritoneal cavity; it is clear, turbid or purulent, according to the time that has elapsed since perforation occurred. The foreign body is protruding through the bowel wall, plugging the opening. Very rarely it is lying free in the peritoneal cavity. Sometimes more than one perforation is seen. The loop of gut involved is inflamed and thickened with intramural exudate. It is covered with a variable quantity of adherent fibrin which, however, can be easily peeled from it. Slow spasmodic waves of contraction are seen. Later a general dilatation of the gut occurs owing to the paralytic effect of the toxins. Gross intestinal soiling of the peritoneum is rarely, if ever, apparent. The loop of gut containing the foreign body usually lies in the lower pelvic region. It is an easy matter to find it, as the walls are thickened and the foreign body, if of any appreciable size, seems to be the first thing felt by the examining hand.

The second condition that may be found to have occurred is slow perforation. Omental reaction and adhesions round the loop of gut, sealing off the stoma and the protruding foreign body, are found. This forms a mass which is easy to discover. An intraomental abscess is usually present in the centre of the mass. The foreign body may be lying free in the abscess. The peritoneal exudate varies according to the amount of contamination from the abscess and may be absent altogether.

Argument.

The difficulties that have been experienced in diagnosing this condition have been mentioned. The clinical findings depend to a large extent on the pathological processes present in the peritoneal cavity. These, although similar in kind, can vary considerably in degree. However, it is evident that there must be certain features common to all cases.

1. The foreign body must pass along the intestinal canal. A large body may cause some degree of abdominal distress in doing this.

2. It must reach a part where finally it becomes impacted or where the point engages in the mucosa.

3. Here it slowly ulcerates the wall by pressure or the point works its way through during the waves of peristalsis. In either case, the bowel

endeavours to force on the intruder by increasingly violent muscular contractions; this results in attacks of colic. Disengagement and reengagement may occur, causing several perforations.

4. Infection of the peritoneal cavity then takes place. This infection may be minimal or it may be maximal, depending on the effective size of the perforation. If the perforation is minimal or the erosion slow, the omentum will endeavour to seal off the area. If the perforation is larger, gross infection of the peritoneum will result and may be localized or diffuse, depending on the amount of the leakage.

5. As the terminal portion of the ileum is usually affected, as the involved loop of gut lies low in the abdomen and as the peritoneal exudate tends to find its way downwards, the lower part of the abdomen should present features of clinical note, and these features should be most marked somewhat on the right side, though not invariably so.

The larger foreign bodies, such as poultry or meat bones, should cause more acute symptoms; the smaller, such as bristles or fine fish bones, should cause more subacute symptoms; for these larger bodies, with their serrated and razor-like edges, are more likely to cause larger and more rapid perforations.

If these assumptions are correct, it is suggested that in a typical case of acute perforation of the small gut by a foreign body the following clinical features should be present: (*a*) Persistingly recurrent attacks of colicky abdominal pains. (*b*) Signs and symptoms of acute peritoneal inflammation superimposed on the attacks of colic. (*c*) Signs or symptoms or both, maximal in the lower part of the abdomen, perhaps somewhat on the right side. These characteristic features may be modified in any particular case by the factors mentioned previously—slowness of perforation, smallness of the perforation and influence of the omentum. In these atypical cases, nevertheless, the pain of onset, in whatever way it is described, is usually found to be a type of colic. On the other hand, several cases conform exactly to the description given above and more than half of those studied are close approximations to this typical clinical picture.

CASE REPORTS FROM THE LITERATURE.

The following is a brief résumé of each of the nine cases reported in the literature and studied for the purposes of this article. The descriptions given are taken *verbatim* from these reports, and nothing essential, if mentioned, has been omitted. The features stressed are enumerated in this order: (i) the time since onset, (ii) the symptoms, (iii) the abdominal signs, (iv) operative findings and (v) remarks.

GRAHAM'S CASE.—(i) Forty-two hours. (ii) Colicky umbilical pains, later black vomiting. (iii) Hernial orifices closed; no tumour felt; rectum clear; fluid dulness in flanks. (iv) Peritoneal exudate. Distended small intestine. A piece of wire bristle piercing the ileum near the caecum and passing into an appendix epiploica of the caecum, pinning another loop of ileum in between. On removing the wire the obstruction was relieved. The bristle was $1\frac{3}{8}$ inches in length. (v) The patient could not remember having swallowed it. Clinically this was a case of intestinal obstruction.

ARMITAGE'S CASE.—Woman, aged forty-eight years. (i) four days. (ii) Sudden severe stabbing abdominal pain associated with vomiting. (iii) Distended abdomen, general rigidity, particularly of lower abdomen. (iv) Free brown pus in abdominal cavity. Intestines generally distended and inflamed. Ileum perforated by a fish bone. Two other similar bones, perforating the gut, found close by. (v) Patient had a meal of fish two days before onset. Approximates typical case.

GAITHER'S CASE.—Girl, aged eighteen years. (i) and (ii) Severe lower epigastric and umbilical pain for about one month; intermittent severe colicky pain occurring at irregular intervals. Recent sudden onset of excruciating generalized abdominal pain. (iii) General abdominal tenderness and board-like rigidity. Tenderness decidedly more marked in the right lower quadrant. (iv) Clear straw-coloured fluid in peritoneum. A loop of brittle stiff terminal ileum presented with an open stigma, half a centimetre at the apex of the curve. A prune seed was found loose in peritoneal cavity. (v) Approximates typical case.

Gaither made an exhaustive study of the literature from 1731 to 1933, and found but three other cases of a foreign body lying free in the peritoneal cavity, following a perforation of the ileum. All the foreign bodies were bones; one was found at autopsy and in the other two cases the patients were operated on and one died. He remarks that there are no recorded subjective symptoms or objective signs particularly indicative or pathognomonic of this entity, and in not one instance was the condition diagnosed before operation or before autopsy.

GARBERSON'S CASE.—Male, aged twenty-three years. (i) A few hours. (ii) Sudden severe cramping pain in abdomen associated with nausea, but not with vomiting. (iii) Abdomen moderately rigid. Rebound tenderness. Pain and tenderness seemed to be definitely localized in the right lower quadrant. (iv) Purulent fluid in abdominal cavity. A small perforation, surrounded by inflammatory reaction, found about two feet below the duodeno-jejunal flexure. A porcupine quill 2·6 centimetres long by 2·0 millimetres across found free in peritoneal cavity. (v) Three days before, the patient had pulled porcupine quills from a ranch dog; he was amazed to learn that he had swallowed one. Approximates typical case.

GINZBERG AND BELLER'S CASE.—(i) and (ii) Recurrent generalized abdominal colic at intervals for the past few weeks. Three days ago pain became much more severe and tended to localize in right lower quadrant. (iii) Moderate distension with direct and rebound tenderness equal in both lower quadrants. (iv) Considerable serosanguinous fluid. Intestines covered with scattered areas of fibrin . . . a dilated and congested loop of ileum encountered. Immediately below it the gut was slightly collapsed. An area of necrosis about two centimetres in diameter with a small perforation at its centre. This was due to a chicken bone two inches in length, lying transversely in the bowel. (v) Approximates typical case.

These writers state that signs and symptoms of peritonitis are present, but are too indefinite to give any clue as to the point of origin. A diagnosis of appendicitis is usually made. They also report two cases of perforation of the small intestine in a hernial sac by a foreign body; in each of these the hernia itself was the seat of clinical interest and they will not be discussed further.

BLACK'S CASE.—Male, aged twenty-three years. (i) and (ii) Three months' history of umbilical pain with nausea. Frequent similar attacks since, lasting ten to fifteen minutes. Three days before admission a similar but more severe attack. (iii) Slight deep tenderness at McBurney's point. No rigidity and no hyperæsthesia. (iv) Free serous fluid. Omentum adherent to a loop of ileum in the pelvis. A piece of wire, partly within and partly without the lumen of the gut, partly covered by omentum. Wire two inches long and of thickness of darning needle. (v) Black draws attention to the following points: How was the wire swallowed without being noticed? The site in the pelvic ileum—why here? Nature's method of dealing with it. The ease with which it may have been missed.

SPEESE AND BOTHE'S CASE.—Two years before, the terminal ileum, caecum and ascending colon were resected because of diagnosis of malignant tumour (microscopically benign); a lateral anastomosis between ileum and transverse colon was made. (i) and (ii) Four weeks before admission an attack of severe abdominal pain with urinary symptoms, urinary deposits, and vomiting. Regarded as acute pyelitis because of

tenderness over right kidney and abdominal pain and tenderness most pronounced over the bladder. Five days ago, recurrence of severe intermittent abdominal pain. Pain localized to right lower quadrant and radiated down right leg and into genitalia. Considerable pain at end of urination. Constipation first, then profuse diarrhœa. Urine examination negative. (iii) Generalized abdominal tenderness and rigidity most pronounced in right lower quadrant, at the lower end of the right rectus scar from the previous operation. Several days later a mass became apparent and operation was performed. (iv) No free fluid. Inflammatory mass in ileo-colic region; it was an abscess containing foul-smelling pus. A triangular-shaped chicken bone, three by one centimetres, was protruding from the wall of the terminal ileum at the site of the anastomosis into the abscess. (v) Approximates typical case.

WEBB'S CASE.—Female, aged fifteen years. (i) Six hours. (ii) Severe cramp-like pains in right lower quadrant. (iii) Lax abdomen. Marked tenderness in right lower quadrant extending well down towards the pelvis. Marked rigidity throughout the tender area, but no distension. (iv) Turbid fluid in right lower quadrant and in pelvis. Small intestine inflamed. Meckel's diverticulum, about size of thumb of ordinary rubber glove, perforated by fish bone half an inch from its tip. (v) The patient had eaten fish one and two days before onset. Webb reports five previous cases from the literature of perforation of a Meckel's diverticulum by a foreign body, with two deaths. Approximates typical case.

DONOVAN'S CASE.—Boy, aged eleven years. (i) Twenty-four hours. (ii) Severe pain in right lower quadrant. Generalized at first and then tending to localize in right iliac fossa. (iii) A typical picture of acute appendicitis presented itself. (iv) The appendix lying in a pool of lymph, did not look bad enough to have caused the acute picture. Meckel's diverticulum next considered. Eighteen inches from the ileo-caecal valve a diverticulum slightly under two inches long was found, with a foreign body projecting three-quarters of an inch from its tip. The intestine about the diverticulum was red and congested. The foreign body was a splinter of wood one inch long.

In this group, nausea and vomiting are variable symptoms and may be absent. The temperature is usually elevated slightly to around 99° or 100° F. The pulse rate is usually lower than the temperature reading.

An analysis of the full series of fifteen cases, from the point of view of the features suggested as an aid in the diagnosis of this condition, reveals the interesting fact that these features actually are present in the majority of the cases. It is the writer's contention, therefore, that a clinical syndrome consisting of intestinal colic, peritonitis and lower abdominal locus may be accepted as characteristic of perforation of the small intestine by a foreign body contained within its lumen.

DISCUSSION.

In a consideration of the diagnoses that have been made, the cases can be divided into three groups: (i) Acute cases. The condition is diagnosed as acute appendicitis and usually a localized peritonitis was present. (ii) Acute cases. The condition is diagnosed as peritonitis, of obscure origin; usually a diffuse or, more correctly, a widespread lower abdominal peritonitis was present. (iii) Subacute cases. This is a small but extremely variable group; an omental mass with intraomental abscess usually was found. Speaking generally, the symptoms in groups (i) and (ii) were present for a matter of between hours and days, with those in group (ii) the more acute in onset. In group (iii) the symptoms were present for a longer period, between days and weeks.

Group (ii) included the majority of cases reported. If each case is taken separately, the diagnostic problem is obvious; but when the cases are considered together, there are certain common clinical features in the group

which, as has been pointed out, may suggest the correct diagnosis. The intestinal colic, by whatever name it is described, is usually severe and figures prominently in the patient's story; it may be generalized, umbilical, in the right lower part of the abdomen or, in very acute cases, in the suprapubic region. The tenderness and the rigidity of the lower part of the abdomen are striking objective findings. They are sometimes maximal in the lower right quadrant, but in the most characteristic examples they are maximal in the mid-line or only slightly to the right. Even after some hours have elapsed since the onset of the illness, when intestinal distension has become apparent, the tenderness and the rigidity are sufficiently obvious to suggest that the condition is not one of organic intestinal obstruction, and actually, except in one case, this diagnosis was not considered. These cases do not resemble acute peptic perforation—the site of trouble is so obviously in the lower part of the abdomen; further, the rigidity is not so extreme as in peptic perforation. The writer's third case is very typical. It did not resemble a case of acute appendicitis. It was too fulminating. There was no nausea or vomiting. Colicky pains started in the suprapubic region and soon spread all over the abdomen. The maximum tenderness and rigidity were situated in the lower part of the abdomen, both sides being equally affected. The less hyperacute cases and those in which the patients are not seen by a physician until a day or so has elapsed after the onset of the illness, may superficially resemble acute appendicitis, but in the majority there are features that do not fit in with this diagnosis. Consequently such a condition has usually been described as peritonitis of obscure origin. It is in such cases that the suggested syndrome of colic, peritonitis, lower abdominal locus, may prove to be of value in the making of a definite diagnosis before operation.

TREATMENT.

It is essential to remove the foreign body and to close the openings in the gut. Drainage of the peritoneal cavity may, or may not, be advisable. In certain instances, excision of omentum is necessary. In one case a loop of ileum was resected.

SUMMARY.

1. Five cases of perforation of the ileum and one case of perforation of a Meckel's diverticulum by an ingested foreign body have been reported. In addition, nine cases from the literature have been reviewed.

2. The condition is not common, and apparently has never been diagnosed before operation or autopsy.

3. This is because of a close similarity to acute appendicitis in some cases; in others, the clinical features have been too confusing to suggest an origin for the peritonitis.

4. This latter group may be confusing because of the rarity of similar cases in any one surgeon's experience.

5. To aid in the diagnosis of the condition a theoretical postulate, consisting of (*a*) colic, (*b*) peritonitis, and (*c*) lower abdominal locus, has been advanced.

6. When analysed, many of the acute cases actually do approximate to this theoretical concept.

7. The influence of the omentum and of the effective size of the perforation has been stressed as modifying the above features of a typical case.

8. Although uncommon, a perforation of the small gut by a foreign body should be kept in mind as a possible cause of an obscure peritonitis.

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THE IMMEDIATE AND REMOTE EFFECTS OF MINOR LESIONS OF THE CERVICAL PORTION OF THE SPINAL CORD FOLLOWING HEAD INJURY.[1]

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MINOR traumatic lesions of the cervical portion of the spinal cord are often overlooked. They arise usually from force applied to the front or back of the head. It is because of the transient effects of the blow to the head as often as because of the more obvious effects of cerebral contusion that the head injury distracts attention from the spine and spinal cord. This occurs even in the presence of fracture-dislocation of the spine, but is more common in the absence of gross injury to the vertebral column. There are, however, usually some indications of injury to the cervical portion of the spinal cord immediately after the accident.

Jefferson (1927) has shown that injury to the spinal column in the cervical region from force applied to the head occurs at two particular levels; and he has analysed the factors responsible for these sites of election. The commonest site is that at or about the body of the fifth cervical vertebra; and the site less often affected is that at or about the second cervical vertebra. This grouping concerns, however, injury to the vertebral column itself, and directs attention to abnormalities of the skeletal framework rather than to those of the spinal cord. It is probable that the levels of greatest injury to the spinal cord correspond closely to these two levels. Riddoch (1927) has pointed out that in cases of fracture-dislocation of the spine associated with severe injury to the spinal cord the three sites of the vertebral column most often injured are such that the levels of sensory involvement are clearly defined because of the apposition on the surface of the body of segmental areas which are not anatomically in series. Nevertheless, cases of minor injury to the cervical portion of the spinal cord present themselves as neurological problems without direct reference to an injury. Injury to the spinal cord should be investigated primarily in terms of injury to the spinal cord itself instead of as a complication of injury to the vertebral column. Injury of the spinal cord may not occur when the vertebral column is injured, may be associated with injury to the vertebræ, or may occur without it.

The problem has been approached in this way by Walshe and Ross (1936), who reported six cases of minor damage to the cervical portion of the spinal cord. Only one of their six cases had been recognized, the diagnoses given varying from progressive muscular atrophy to amyotrophic lateral sclerosis and arthritis of the shoulder joint. They pointed out that the clinical picture of minor traumatic lesions of the cervical portion of the spinal cord was not uncommon, was usually unrecognized and had not been adequately described.

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In only two of their cases was there evidence of abnormality in the vertebral column. Their description was concerned with lesions of this type at the level of the fifth cervical segment, was applied to a lesion which was particularly limited in extent and was based upon the examination of patients some time after the accident. The review that follows is based upon a series of cases in which the patient was seen sometimes immediately after the accident, in some cases a few weeks after it, and in three cases some years after it. In every case but one, however, a reliable history and a record of the condition of the patient immediately after the accident were available. The type of case upon which the study is based may present a broader consideration of the condition under review than that of Walshe and Ross (1936) and at the same time illuminate to some extent the problem defined by Garland (1938) and others of the apparent effect of trauma in the initiation of disease of the nervous system.

CLINICAL OBSERVATIONS.

Observations were made in thirteen cases. Seven were presented originally as examples of an indefinite neurological picture for which trauma proved to be the explanation, four as immediate or remote effects of injury, and two were found in the course of an examination of the effects of cerebral contusion to furnish evidence of minor injury to the cervical portion of the spinal cord. In three cases only had the effects of injury upon the spinal cord been recognized immediately. In ten cases the subsequent development of the clinical picture after an interval of three or more weeks, and in some cases after years, had drawn attention to the effects of trauma upon the spinal cord. In six cases fracture-dislocation of the cervical spine was present; in six cases the spine was normal; and in one case there were changes that suggested the effects of old injury. In two of the first mentioned the fracture-dislocation was not recognized until two and twenty-three years respectively after the original injury, and in two cases until three or more weeks had elapsed. In four of the six cases of fracture-dislocation of the spine the abnormality was in the neighbourhood of the fifth cervical vertebra, and in two it was in that of the second cervical vertebra. The two latter were the cases in which the condition of the cervical spine had escaped recognition for two and twenty-three years respectively.

In six cases the response of the tendon reflexes in the upper limbs varied, one or more being absent and the others present. In two of these six cases fracture-dislocation was present in the neighbourhood of the fifth cervical vertebra, in one there was a possibility of spinal injury in that region, and in the remaining three cases there was no evidence of spinal injury. In two of the four cases with fracture-dislocation in the neighbourhood of the fifth cervical vertebra, the arm reflexes varied as above, and in two they did not vary. The reflexes did not vary in the cases associated with fracture-dislocation in the neighbourhood of the second cervical vertebra.

Cases with a Moderate Degree of Injury to the Spinal Cord.

To approach the study of the effects of the slightest injuries to the cervical portion of the spinal cord it is necessary to examine first the findings in four of the cases in which a somewhat more severe degree of injury had occurred. All of the patients had fracture-dislocation in the neighbourhood

of the fifth cervical vertebra. All, except one in regard to whom the information was not available, received their injuries as a result of force applied to the head. In two cases the possibility of injury to the cervical spine and spinal cord was recognized soon after the accident; in two cases it was not recognized until definite neurological abnormalities were evident some weeks after the accident.

CASE I.—A young man was seen for Mr. T. D. M. Stout in 1933, complaining of weakness of the right hand and slight weakness of the left hand of six weeks' duration. When playing football he had fallen forward and struck the front of his head. Both upper and lower limbs became useless at once. There was a feeling of numbness in the left upper limb. Six hours later power returned to all four limbs. They had improved steadily, but definite weakness became apparent in all movements of the right hand.

On examination the following positive findings were noted. The right pupil was smaller than the left. Nystagmoid jerkings appeared in the right eyeball on deviation of the eyeballs to the right. Wasting, weakness and diminution of tone were apparent in all the muscles of the right hand, front and back of the forearm and back of the upper arm. The muscles of the left hand were slightly wasted and weak. The supinator, biceps and triceps jerks were present and less active on the left side. Sensation for pin-prick was diminished in the distribution of the right second and third dorsal roots and in that of the left second to fourth dorsal roots. The abdominal reflexes were less active on the right side than on the left. All movements of the right lower limb against resistance were slightly weak. The knee and ankle jerks were more active on the right side than on the left. The right plantar reflex was sometimes extensor. Below the distribution of the right tenth dorsal root the appreciation of pin-prick and of heat and cold was impaired. A hot tube was felt as "warm", as was a cold tube. Towards the upper margin of the area of sensory loss pin-prick produced a smarting sensation at times. The left foot and leg were cold and sweated freely.

There was a kyphotic curve, with its maximum about the spine of the fifth cervical vertebra. X-ray examination showed a compression fracture-dislocation with maximum involvement of the fifth cervical vertebra and also affecting two vertebræ below it.

Case I may be summarized as follows. A fall on the front of the head was followed by weakness of all four limbs for six hours. Six weeks later there were found: nystagmus on deviation of the eyeballs to the right; inequality of the pupils; wasting, weakness and diminution of tone in the distribution of the fifth cervical to first dorsal roots on the right side; diminution of sensation for pin-prick in the distribution of the right second and third dorsal roots, and of the left second to fourth dorsal roots; slight right hemiparesis; and loss of sensation for pain and temperature on the right side below the distribution of the tenth dorsal root. X-ray examination revealed a fracture-dislocation involving the fifth to seventh cervical vertebræ.

CASE II.—A young man was seen for Dr. Putnam in June, 1934. Six weeks previously he fell out of a cart and struck the back of his head. He had been in hospital since then.

The following positive findings were noted on examination. He was apprehensive and responded excessively to visual, auditory and painful stimulation. The right palpebral aperture and pupil were smaller than the left. The eyeballs were prominent. The upper eyelids lagged behind the eyeballs when they deviated downwards. The muscles of the right hand and of the front and back of the right forearm were wasted more than those of the left. The supinator, biceps and triceps jerks were over-active. On the right side below the level of the second rib sensation for pin-prick was lost and sensation for cotton wool was unchanged. Motor power against resistance was impaired more in the left lower limb than in the right; in the former muscle tone was increased in the extensors. The knee and ankle jerks were more active on the left side. Frequency and urgency of micturition were present. X-ray examination revealed what appeared to be a crush fracture of the body of the sixth cervical vertebra.

Case II may be summarized as follows. A fall on the back of the head was followed six weeks later by: inequality of the pupils and palpebral apertures; wasting, weakness and diminution of tone more in the distribution of the right than in that of the left seventh cervical to first dorsal roots; slight left hemiparesis; and loss of sensation for pain below the level of the second rib on the right side. X-ray examination revealed what appeared to be a fracture of the sixth cervical vertebra.

CASE III.—A man, aged twenty-one years, was seen for Dr. F. Fitchett in 1927. He had been involved in a motor car accident six weeks before. He was unconscious for three hours and dazed for a few days. Three weeks later he felt stiffness of the neck and pain across the back of the neck and into both shoulders. About the same time both hands became weak. There was also some difficulty in walking. He staggered and fell if not supported and tended to go to one side, a tendency he thought was due to the left lower limb not moving freely.

The following positive findings were made on examination. The left pupil was slightly larger than the right. The muscles of the left hand and forearm were wasted and the corresponding movements were weak against resistance. The muscles of the right hand were also wasted and those of the forearm to a lesser extent. In both upper limbs the biceps jerks were present; and the supinator and triceps jerks were absent. On both sides there was an exaggerated response to pin-prick in the distribution of the sixth cervical to first dorsal roots inclusive. Over the trunk below the level of the second rib on the right side and over the right lower limb sensation for pin-prick and heat and cold was lost. The patient had received a painless burn on the right ankle from a hot-water bag. The abdominal reflexes were absent from both sides. In the left lower limb movements against resistance were impaired, especially in flexion, and muscle tone was increased in the extensors. Both plantar reflexes were extensor.

The cerebro-spinal fluid was straw coloured, contained no cells, and had an increased quantity of protein. X-ray examination revealed a fracture-dislocation of the sixth cervical vertebra forwards on the seventh.

Case III may be summarized as follows. Three weeks after an accident followed by unconsciousness there were pain into both shoulders, weakness of the distal part of both upper limbs and difficulty in moving the left lower limb. After six weeks there were found: wasting, weakness and diminution of muscle tone in the distribution of the seventh cervical to first dorsal roots, more on the left side; increased sensation to pin-prick in the distribution of the sixth cervical to first dorsal roots on both sides; loss of sensation for pain and temperature below the level of the second rib on the right side; left hemiparesis affecting the upper and lower limbs; and both plantar reflexes extensor. On both sides the supinator jerks were present, and the biceps and triceps jerks were absent. X-ray examination revealed a forward fracture-dislocation of the sixth cervical vertebra on the seventh.

CASE IV.—A man, aged thirty-seven years, was seen for Dr. A. Gillies on February 25, 1938. He had been admitted to hospital four days before, though he had met with an accident six weeks before admission. He fell off a lorry and struck the ground with the back of his head and shoulders. He saw a pink flask of light. Then he heard someone asking where the driver was.

He felt tingling in both hands and arms at once. This continued for four days. On the second day he had difficulty in moving the fingers of both hands. About the fourth day there was numbness of the third, fourth and fifth fingers of the right hand. About the same time there appeared pain from the back of the neck to both shoulders and later into the outer aspect of both upper arms. Apparently weakness of the left lower limb was evident during the first four days.

The following positive findings were made on examination. Fine regular nystagmoid jerkings appeared on deviation of the eyeballs to the right and left. The left pupil was sometimes larger than the right. There was excessive tremor of the eyelids. The left corneal reflex was somewhat slower than the right. The left lower face lagged a little for voluntary movements, but not for emotional movements. The

face was stiff and a pronounced tonic tremor appeared in the facial muscles on voluntary movement. The small muscles of the hands and to a lesser extent the muscles of the forearms, upper arms and shoulder girdles were wasted. Sensation for pin-prick was diminished in the distribution of the seventh cervical to first dorsal roots on both sides. The left supinator and biceps jerks were not elicited; the triceps jerk was present and active. In the right upper limb all the tendon reflexes were present. The Mayer thumb reflex was absent. In the right lower limb the knee and ankle jerks were very active and the plantar reflex gave no response. In the left lower limb motor power against resistance was impaired; the knee and ankle jerks were over-active, and sensation for vibration was impaired.

Four days later the supinator and triceps jerks were present on both sides, and the biceps jerks were absent. X-ray examination revealed crowding of the bodies of the fifth, sixth and seventh cervical vertebræ, with displacement of the body of the fifth forward on that of the sixth.

Case IV may be summarized as follows. Following a fall on the back of the head, tingling appeared in the upper limbs for four days. Within three days there appeared: weakness of both hands; numbness of the third, fourth and fifth fingers of the right hand; weakness of the left lower limb; and aching across the back of the neck into the shoulders and later into the upper arms. Six weeks later there were found: wasting, weakness and diminution of tone throughout both upper limbs, but mostly in the hands; impairment of sensation for pin-prick in the distribution of the seventh cervical to first dorsal roots on both sides; a very slight degree of hemiparesis affecting the upper and lower limbs; and impairment of sensation for vibration in the left lower limb. Four days later the biceps jerks were absent on both sides, while the supinator and triceps jerks were present. X-ray examination revealed a forward fracture-dislocation of the fifth cervical vertebra on the sixth.

Certain features are apparent at once from an examination of the clinical findings in these cases.

There were immediate effects in every instance, in some cases becoming less or disappearing, and in others continuing until more persistent effects supervened. In spite of the remarkable similarity of the effects of the accident upon the vertebral column, the neurological findings differed considerably at the end of six weeks. In two cases the cervical sympathetic was involved; in two cases it was not affected.

In spite of the local nature of the vertebral injury, involvement of the spinal cord as shown by disturbances of motor and sensory functions was very widespread. In two cases motor injury involved practically all the segments concerned with the upper limb on both sides or more on one side than the other. In two cases it involved three or more segments, more on one side. For sensation, two or more segments were involved in one case at a level well below that of the vertebral injury; in one case there was hyperalgesia corresponding to four segments approximately at the level of the vertebral injury; and in two cases there were no segmental sensory changes at all.

Evidence of involvement of long paths in the spinal cord also varied. Control of the bladder was not affected. Motor power was only slightly affected, the hemiparesis noted in three out of four cases being very slight. Interruption of sensory paths was indicated by loss of sensation for pain and temperature below the level of the second dorsal segment on one side in two cases, below that of the tenth dorsal segment on one side in one case, and only by impairment of vibration at one ankle in one case.

If the damage to the spinal cord were produced by temporary nipping of the spinal cord, pressure upon it or crushing of it, it would be expected that the neurological findings would indicate a limited and fairly well-defined lesion. They fail to do so, pointing rather to widespread lesions through a considerable length of the cervical portion of the spinal cord, with varying damage to the structures contained in it. Thus momentary stretching of the spinal cord with varying degrees of disturbance of physiological continuity is a more probable cause of neurological effects than any direct mechanical damage, even in the presence of fracture-dislocation of the spine.

Cases with a Minor Degree of Damage to the Spinal Cord.

The following six cases were characterized by a minor degree of damage to the cervical portion of the spinal cord. None of the patients had fracture-dislocation of the cervical spine. The cases are outlined as far as possible in decreasing order of severity of the neurological effects.

CASE V.—A man, aged twenty-seven years, was seen for Dr. Macdonald Wilson on September 10, 1934. He had been involved in a motor car accident and was admitted to hospital eight days before. On admission he complained that he had been unable to move his arms and legs, and he had wounds of the lips and forehead. The only finding on examination of the nervous system was some reluctance to move the upper limbs. Next day the patient complained of pain in the lower part of the neck and out to both shoulders, aggravated by movement of the head. There was some weakness of the upper limbs, more on the right side.

He said that he had been the driver of an open motor car which had capsized onto a beach. He remembered the front of his head coming into contact with the shingle. From the time of the accident he had a feeling of numbness and tingling over the upper and lower limbs and the trunk. There had been difficulty in moving the upper and lower limbs. For two days after the accident he had difficulty in beginning to empty the bladder, even when the desire to do so was strong. Aching in the back of the neck and out to the shoulders appeared the day after the accident.

The following positive findings were made on examination. There were wounds of the upper lip and forehead. Both upper eyelids drooped and were tremulous, the drooping being readily overcome. The eyeballs were slightly proptosed and the pupils were dilated. In the shade the left pupil was larger than the right. The left pupil contracted more slowly to direct and consensual light than did the right. In all muscle groups of the right upper limb, but more in the hand, there were impairment of motor power against resistance and definite diminution of muscle tone. The right supinator, biceps and triceps jerks were present, but difficult to elicit. In the left upper limb motor power was impaired to a much less extent. The right abdominal reflexes could not be elicited. In the right lower limb motor power was impaired in all parts against resistance. Vibration was not felt at the ankles as well as it should have been in a man of the patient's age. X-ray examination of the cervical spine revealed no evidence of fracture-dislocation.

Five days later the eyeballs were less prominent. Movements of the left upper limb were normal; those of the right upper limb were much improved, but extension of the forearm was weak. The tendon reflexes of the right upper limb and the right abdominal reflexes were not elicited.

Three weeks later and six weeks after the accident the right upper limb was much improved. The grip of the right hand was a little less than that of the left hand. The soft tissues of the right hand were swollen and congested. The nails of the right fingers were growing at half the rate of those of the left fingers. The supinator jerk was absent; the biceps and triceps jerks were present. The right lower limb moved slightly less freely than the left.

Case V may be summarized as follows. Immediately after a fall on the front of the head there appeared spontaneous sensations in the trunk and all four limbs, slight weakness of the upper limbs, more than those of the lower limbs, and delay in the beginning of micturition. One week after the accident

there were found: proptosis of the eyeballs with inequality and dilatation of the pupils; weakness and diminution of tone more in the right upper limb than in the left; slight right hemiparesis; and lessened appreciation of vibration in both lower limbs. After six weeks there was much recovery. Evidence of vasomotor paresis appeared in the right hand; and the supinator jerks were absent, while the triceps and biceps jerks were present.

CASE VI.—A man, aged sixty years, came under attention on December 18, 1936. Seven weeks before a piece of planking had fallen out of a sling and struck him on the head. When he recovered consciousness he felt pains across both shoulders and tingling throughout the whole of both upper limbs. He was discharged from hospital after one week. About two weeks after the accident he noticed the muscles of both arms, especially in the upper part, "going to nothing". He had difficulty in picking up objects, more so with the right hand than with the left.

The following positive findings were noted. There was a scar three inches long on the left side of the forehead. On both sides the muscles of the shoulder girdle, upper arm and hand were wasted. Movements of the hands and at the shoulder and elbow were weaker on the right side than on the left. The tendon reflexes were present. There was resistance to movements of the head backwards and forwards. Vibration was not felt at the right ankle. X-ray examination revealed changes due to extensive arthritis of the cervical and upper dorsal parts of the spine.

Up to ten weeks after the accident the wasting of muscles and the difficulty in the use of the limbs became worse. At that time the patient still felt tingling in both upper limbs, there was difficulty in moving the head backwards and forwards, and pains were still present across the shoulders. Six months after the accident the condition of the muscles had improved to some extent.

Case VI may be summarized as follows. Immediately after an injury to the front of the head with loss of consciousness there was tingling in both upper limbs. Weakness and wasting of the limbs appeared three weeks later. Six weeks after the accident there were found: weakness, wasting and diminution of tone in the distribution of the fourth cervical to first dorsal roots, more on the right side; and failure to appreciate vibration at the right ankle. X-ray examination revealed extensive arthritis of the cervical and upper dorsal spine.

CASE VII.—A Chinese, aged fifty-two years, seen in 1927 for Dr. F. Fitchett, complained of pains in both arms and of some weakness of movements. His description of the pain was somewhat indefinite, but it seemed that he felt it in the third, fourth and fifth fingers on both sides. About five months before he had fallen and developed pain in and weakness of both upper limbs. These symptoms disappeared in three weeks. Again, three weeks before he came under observation, he had fallen five feet onto the ground and struck his head. Thereafter pain appeared in the left side of the neck and both upper limbs, and movements of the left upper limb were weak.

The following positive findings were made on examination. The small muscles of the hand and the muscles of the forearm, upper arm and shoulder girdle were wasted, more on the left side than on the right. Movements against resistance were slightly weak, especially in the hand. The right supinator jerk was over-active, the biceps jerk was present and the triceps jerk absent. The left supinator and biceps jerks were present, and the triceps jerk was absent. The right abdominal reflexes could not be elicited; the left were present. Movements of the left lower limb against resistance were slightly weaker than those of the right. The right plantar reflex was sometimes extensor; the left was flexor.

The pain gradually disappeared; the tendon reflexes of the upper limbs reappeared and motor power in the upper limbs recovered.

Case VII may be summarized as follows. Following a fall five months before there developed weakness and pain in both upper limbs, which disappeared after three weeks. A second fall three weeks before was followed by the same symptoms. There were found: wasting, weakness and diminution of muscle tone in the distribution of the fourth cervical to first dorsal roots,

more on the left side; and a slight degree of right hemiparesis involving the upper and lower limbs. On both sides the triceps jerk was absent and the others were present.

CASE VIII.—A man, aged twenty-four years, was seen for Dr. H. K. Corkill on February 25, 1938. Four weeks before he had struck the top of his head on a beam. He saw black, vision was blurred and he was confused for two hours. Since then there had been recurrent attacks of headache and vomiting. The back of the neck was painful immediately after the accident and continued so for two weeks. Throughout, with movement of the head, tingling appeared in the upper and lower limbs for five minutes at a time. At night there were sudden jumps of the upper and lower limbs.

The following positive findings were noted on examination. The left pupil and palpebral aperture were larger than the right. There were some wasting, weakness and diminution of tone in the small muscles of the hands. The supinator jerks were present on both sides; the biceps and triceps jerks could not be elicited. Flexion and extension of the neck were limited.

Case VIII may be summarized as follows. Following a blow on the head the neck was painful. For the next six weeks movement of the head was followed by tingling in the upper and lower limbs. There was slight wasting of the muscles of the hands. The biceps and triceps jerks were absent; the supinator jerks were present.

CASE IX.—A man, aged forty-seven years, was referred by Mr. David Mitchell on May 9, 1938, complaining of numbness of the hands and left foot of about six weeks' duration. About six weeks before he was found in the early hours of the morning having fallen on a concrete path near his home with a scalp wound in the back of his head. Sensations of burning and pins and needles spread up his arms whenever they were touched. During the week he spent in hospital he could not bear his hands to be touched. Since then he had continued to have numbness in the hands and pins and needles shooting up his arms whenever his hands were touched.

Positive findings on examination were as follows. There was a scar in the back of the scalp. In the upper limbs sensation for pin-prick was diminished in the distribution of the right fourth to eighth cervical roots and the left fifth to eighth cervical roots. The right knee and ankle jerks were more active than the left.

He came under attention again on June 14, 1938. The above findings were unchanged. When he put his hands to his head during washing, a tingling sensation passed through the lower limbs, trunk and upper limbs. It disappeared when he supported his head on his hands or when he lowered his arms. It also appeared when there was jarring or vibration nearby. On examination the sensation was produced when he bent forward, raised his hands to or above his head or stamped his feet on the floor. With the head and shoulders firmly supported, these manœuvres were not followed by the sensation.

Case IX may be summarized as follows. Following a fall on the back of the head, spontaneous sensations appeared in the upper limbs and were aggravated or initiated by touch to the hands. Similar sensations continued to appear in all four limbs and the trunk, even three months after the accident, in response to raising the arms, bending the head forward or vibration nearby. They did not occur in response to these factors when the head was firmly supported. Sensation for pin-prick was impaired in the distribution of the right fourth to eighth cervical roots and the distribution of the left fifth to eighth cervical roots. The right tendon reflexes were more active than the left.

CASE X.—A woman, aged fifty-seven years, was referred by Dr. H. Steele on February 23, 1938, with symptoms of two months' duration. Owing to the collision by another motor car with the back of a motor lorry, in the cab of which she was sitting, her head went forward and then back, striking the back window of the cab twice. She suffered severely from characteristic effects of cerebral contusion for the first four days, and continued to have headaches for three or four hours daily until she came under

attention. She said that immediately after the accident she felt tingling in both upper limbs from the shoulders to the fingers. These sensations continued for three or four days and had recurred at intervals since then when she bent her head forward. Physical findings were limited to those of a condition which had been present before her accident.

Case X may be summarized as follows. For four or five days after an accident in which the back of the head was struck and the head thrust forward violently, tingling appeared in both upper limbs and thereafter recurred in response to forward movement of the head.

In this group of cases symptoms were present immediately after the accident in every instance, but in five the possibility of injury to the cervical portion of the spinal cord did not arise until the appearance of definite neurological defects in two cases, and until the patients came under investigation in three instances. One symptom was constant. This was tingling in both upper limbs, which was sometimes associated with tingling in both lower limbs and the trunk. Occasionally the neck felt stiff, or aching appeared from the back of the neck to both shoulders. In one case all four limbs felt useless for a few hours after the accident.

The remote effects varied considerably. In three cases tingling occurred in the limbs in response to various movements of the head. In three cases there was evidence of motor injury over six segments, and in one case of sensory injury over five segments. Irritation of the sympathetic path on both sides occurred in one instance. In one case evidence of vasomotor paresis supervened in one hand after six weeks, a symptom resembling that of the Morvan type of syringomyelia. Long paths in the spinal cord were only slightly affected, the motor path being involved on one side in two cases, and there being failure to appreciate vibration in the lower limbs in two cases. Delay in beginning the act of micturition occurred in one case. In three cases only there was evidence in the tendon reflexes of maximum involvement of an individual segment, one tendon reflex being absent and the other two being present in one or both upper limbs. As a rule, there was evidence of injury to a considerable length of the spinal cord in the cervical region.

Cases with Remote Effects of Minor Injury to the Spinal Cord.

In the following three cases the effects of injury to the cervical portion of the spinal cord at the time of the accident were comparatively slight. In each case, however, the patient eventually came under attention for neurological disabilities which were related to the injury only after the history and the present condition of the patient had been investigated in detail. In two cases previous diagnoses had varied from progressive muscular atrophy to amyotrophic lateral sclerosis and syringomyelia.

CASE XI.—A woman, aged twenty years, was referred by Mr. David Mitchell on August 1, 1936. She complained of stiffness of the right side of the neck, sensations of pins and needles in both arms and stiffness of the right leg of six months' duration.

Two years before, when doing gymnastics, she tried to support herself with her head on one chair and her heels on another. She fell to the floor and at once felt her neck stiff on the right side. She did not seek advice for two years after what appeared to have been a minor accident.

Six months before she came under observation she noticed that her right leg became stiff for an hour at a time. The right hand had been affected for six months, but she paid little attention to it. The stiffness of the right side of the neck had continued throughout.

Positive findings on examination were as follows. She breathed very noisily, not owing to nasal obstruction. When she rotated her chin to the right, she complained of stiffness in the right side of the neck. Against resistance rotation of the head to the right and left was weak. The right spinati, rhomboids, deltoid, muscles of the upper arm and *supinator longus* were wasted. All the other muscles of the right upper limb, including the hand muscles and also the left spinati and deltoid, were wasted to a lesser extent. All movements of the right upper limb against resistance were weak, the maximum weakness being at the shoulder joint. The right supinator, biceps and triceps jerks were more active than the left. There was occasional difficulty in recognizing pin-prick in the left upper limb. The right abdominal reflexes were less active than the left. In the right lower limb motor power against resistance was weak. The right knee and ankle jerks were active and more abrupt in onset than the left. The right plantar reflex was extensor; the left gave no response. Pin-prick was often not felt as pain over the right leg and foot. Vibration was felt very faintly over the left malleoli. X-ray examination revealed fracture of the body of the third cervical vertebra with fragmentation and compression on the right side. The body of the second cervical vertebra was displaced slightly forwards.

Case XI may be summarized as follows. Eighteen months after a fall associated with the catching of the occiput on the edge of a chair and flexion of the head, there appeared stiffness of the right upper and lower limbs. Two years after the accident there were found: wasting, weakness and diminution of tone in the distribution of the right fourth to sixth cervical roots, to a lesser extent in the distribution of the roots down to and including the first dorsal, and also in that of the left fifth cervical root; difficulty in recognizing pin-prick in the left upper limb; right hemiparesis affecting upper and lower limbs; and difficulty in recognizing pin-prick in the right lower limb and vibration in the left lower limb. X-ray examination revealed fracture-dislocation of the second and third cervical vertebræ.

CASE XII.—A man, aged thirty-nine years, was seen for Dr. S. D. Rhind in April, 1938. At the age of sixteen years he fell on his head in a gymnasium. The whole body and both upper and lower limbs became limp, felt dead and had a feeling of pins and needles for three days. Thereafter, whenever the top of the head was bumped or when he threw his head back quickly, he felt pins and needles throughout the trunk and limbs and loss of power for the time. There were several accidents with this result, the last being at the age of thirty years, when he hit his head on shingle when diving into a river. Throughout he had aching pain like rheumatism from the base of the skull to the right shoulder. Nine months before he came under observation he noticed weakness in the back and of the upper and lower limbs after some unusual exertion on his farm. A feeling of pins and needles appeared in the fingers of the right hand. The right lower limb became weak and the foot dragged. The feeling of pins and needles in the right hand gradually spread to involve the whole of the right upper limb. During the past two weeks the right upper limb had become weaker, the right lower limb was a little weaker, pins and needles appeared in the right foot, and similar sensations had appeared in the left hand. Pins and needles appeared in the right hand when it was touched.

The positive findings on examination were as follows. There was a little nystagmoid jerking of the eyeballs on conjugate deviation to the left. The left corneal reflex was slower than the right, and the left cornea was less sensitive to touch with cotton wool than the right. In the distribution of the right second and third cervical roots there was impairment of sensation for pin-prick, shading gradually to normal sensation below and at the back of the head, and with a fairly well defined border adjoining the distribution of the trigeminal nerve. There was also impairment of sensation for pin-prick in the distribution of the left second to fourth cervical roots with a fairly well defined border below and along the angle of the jaw and shading upwards at the back of the head. In these areas, to the stroke of a pin there was excessive mottling to the side of the stroke, persisting much longer than the narrow line of mottling that appeared in response to a similar stimulus elsewhere, and followed by a definite urticarial wheal along the line of the stroke. This response was more obvious on the right side than on the left. In the right upper limb there was considerable diminution of motor power against resistance, more obvious distally. The small muscles

of the right hand had less tone than those of the left hand and seemed a little less bulky. Elsewhere muscle tone was increased slightly in the flexors of the right upper limb. On effort elsewhere and especially in the left upper limb, there were an increase of tone in the flexors of the right upper limb and movement of the limb into a position of full flexion. Appreciation of vibration was diminished at the right wrist. Changes in position of the fingers were not recognized constantly. Sensation for pin-prick was impaired in the distribution of the left eighth cervical and first dorsal roots, shading gradually to the adjacent areas of normal sensation. The right abdominal reflexes were less active than the left. Flexion at the right knee and hip was weak and dorsiflexion of the right foot was impossible. Muscle tone of the extensors was increased, especially distally. The right knee and ankle jerks were more active than the left. The right plantar reflex was extensor; the left, flexor. Stimulation of the right lower limb by pin-prick anywhere up to the middle third of the thigh was followed by transient flexion of the right lower limb as a whole. Flexion of the head was limited. X-ray examination revealed a forward fracture-dislocation of the axis on the third cervical vertebra.

Case XII may be summarized as follows. A fall on the head twenty-three years before was followed by weakness and spontaneous sensations below the level of the neck. These symptoms disappeared in three days. They recurred at intervals in response to pressure on or extension of the head. Throughout there had been aching from the base of the neck to the right shoulder. During the past nine months there appeared progressive weakness of the right upper and lower limbs; and spontaneous sensations appeared at first in the right upper limb and later in the right lower limb and left upper limb. At that stage there were found: right hemiplegia; impairment of sensation for pin-prick and vasomotor paresis in the distribution of the right second and third cervical roots and in that of the left second to fourth cervical roots; impairment of appreciation of vibration and changes of position in the right upper limb; and impairment of sensation for pin-prick in the distribution of the left eighth cervical and first dorsal roots. X-ray examination revealed forward fracture-dislocation of the axis on the third cervical vertebra.

CASE XIII.—A man, aged fifty years, was referred in July, 1938, complaining of loss of power in the hands and arms of eleven years' duration. He had noticed first, cramp spreading from the fifth finger over the whole of the left hand, and then he began to lose power in the whole of the left hand. Wasting appeared between the left forefinger and thumb. Later the left forearm became weak and its muscles wasted. Twitching occurred for a time in the muscles of the left hand and forearm. During the same year there was some difficulty in using a shearing machine which involved movements of the right forearm. The right hand and forearm gradually became weaker. Two years later numbness appeared in the left foot and still later in the right foot. One of the first symptoms noticed at the onset of the condition was numbness in the left hand. Throughout the illness the left hand had become numb at times. Until twelve months before the patient came under observation, tingling sensations like pins and needles had appeared in the trunk and upper and lower limbs.

The following positive findings were elicited on examination. On deviation of the eyeballs to the left there were nystagmoid jerkings of the left eyeball. In the right upper limb the small muscles of the hand, the *supinator longus* and the muscles of the front of the upper arm were wasted; other muscles of the limb were only slightly wasted. The corresponding movements were weak, and supination of the forearm was impossible. The triceps jerk was present; the supinator and biceps jerks were absent. In the left upper limb the small muscles of the hand, the muscles of the front and back of the forearm and those of the back of the upper arm were obviously wasted; other muscles of the limb were only slightly wasted. The corresponding movements were weak, and pronation of the forearm was impossible. The biceps jerk was present; the supinator and triceps jerks were absent. Appreciation of vibration at the left ankle was impaired. Flexion of the head was limited chiefly in the region of the fifth cervical vertebra. X-ray examination of the cervical spine revealed complete obliteration of the normal anterior curve of the cervical spine, narrowing of the spaces between the bodies of the fourth, fifth and sixth cervical vertebræ, and reduction of

the vertical extent of the body of the sixth cervical vertebra to less than two-thirds of that of the bodies of the other cervical vertebræ.

Less than one year before the onset of the present illness and eleven years before he came under observation the patient had his ribs broken as the result of a fall from a horse. The horse reared, the patient falling off backwards and striking the ground with the back of his head and shoulders. The horse then fell, his head colliding with the patient's chest.

Case XIII may be summarized as follows. Within one year of a fall from a horse the patient had developed numbness in the left hand, tingling in the trunk and limbs under conditions which were not recalled, and wasting and weakness of the muscles, first of the left upper limb and hand and later of the right hand and upper limb. There was wasting in the distribution of four or five cervical roots on both sides. In both upper limbs one tendon reflex was present and the others absent. Vibration was not appreciated at the left ankle. X-ray examination revealed findings suggesting the effects of old injury in the region of the fifth and sixth cervical vertebræ.

In these cases physical disabilities were apparent within one year in one case, within two years in a second case and after twenty-three years in a third case. In Case XI there was only stiffness of the right side of the neck after the accident up to the appearance of physical disabilities, but a fracture-dislocation of the second and third cervical vertebræ was found on X-ray examination. In Cases XII and XIII there were symptoms similar to those which occurred in Cases V to X from the time of the accident up to the time the patient came under observation. In addition, fracture-dislocation of the second and third cervical vertebræ was found in one case and structural variations of the cervical spine in the other case.

THE CLINICAL FEATURES.

The clinical features of a limited lesion have been described already by Walshe and Ross (1936), and it will be sufficient here to outline the clinical features of the group of cases under discussion.

In every case but one it was known that the patient had received an injury to the head, in three cases with application of force to the front of the head, in seven cases to the back of the head, and in two cases to the vertex without any indication of the direction in which force was applied. In one case the patient became unconscious as a result of being involved in a motor car accident and it was not known with certainty how the head and neck had been subjected to force.

In one case only was attention directed away from the spine by the severity of the original injury which had produced loss of consciousness. In most cases the original injury to the head, though slight, had resulted in the possibility of injury to the spinal cord being overlooked, even though some of the presenting symptoms had already occurred. In Case XIII an injury to the chest wall had distracted attention, not only from a possible injury to the spinal cord, but also from the injury to the head.

Symptoms were often present immediately after the accident and were of such a type as to suggest injury to the spinal cord. As injury to the spinal cord is often overlooked in these cases, these symptoms are important and need to be examined in detail. They were present in twelve of the thirteen cases, and may have been present in the remaining case and have been forgotten. The commonest symptom was tingling with or without weakness

of both upper limbs or all four limbs, evident immediately after the accident or on recovery from unconsciousness. These symptoms have been mentioned by Garland (1938) as a personal experience. One or both of them persisted for a period which varied from a few hours to three or four days and then disappeared. In some cases, however, they reappeared with flexion or extension of the head, pressure upon the head or even vibration in the neighbourhood. In Case XII they reappeared under such conditions for twenty-two years before definite physical disabilities arose. Other symptoms were less common immediately after the accident. Pain, usually described as an ache, from the neck to one or both shoulders occurred in four cases. In one case only was the neck described as stiff, and in one case there was temporary disturbance of control of the bladder for two days.

Usually clinical examination after the accident showed little that could be accepted as definite evidence of injury to nervous structures. A temporary weakness of the limbs was often confused with an unwillingness to move the limbs freely for an hour or two after the accident. In only three cases were there more definite findings which continued and merged into those which sometimes became apparent three or more weeks after the accident. In Case III there was weakness of both hands and of the left lower limb; in Case V weakness of the right upper limb was more pronounced than in the left; and in Case VII slight weakness of both upper limbs was present.

In most cases there was a period of freedom from symptoms and physical disabilities, with the exception of tingling or other sensations under special conditions, until three weeks or more after the accident, when more definite physical disabilities appeared. Cases XI, XII and XIII were exceptional in that evidence of physical disability did not appear until one or more years had elapsed. In these cases, however, the pathological basis of the disability was probably different from that in those cases in which disabilities became apparent from three to six weeks after the accident.

In Cases III, V and VII disabilities evident after the accident merged into those which appeared after three or more weeks. In the other cases disabilities which appeared eventually, were not always regarded at once as traumatic in origin, especially when the original injury had been trivial and the immediate symptoms had been overlooked.

Later effects have been summarized in two groups, after the case records of Cases I to IV and after those of Cases V to X. In three cases, however, the clinical features were limited during the time the patients were under observation to tingling in the upper and lower limbs in response to movements of the head, in one case in association with wasting of the small muscles of the hands and in another with segmental analgesia.

Remote effects are illustrated by Cases XI, XII and XIII, in which the clinical picture was such that progressive muscular atrophy, amyotrophic lateral sclerosis and syringomyelia had been considered previously as possible diagnoses.

Involvement of Tendon Reflexes of the Upper Limbs.

Walshe and Ross (1936) have drawn attention to the importance of detailed examination of the tendon reflexes of the upper limbs in the diagnosis of the traumatic origin of the clinical condition in the cases under consideration, and to the value of the inversion of the radial reflex described by Babinski. The present observations are confined to the former. In two cases

there was definite fracture-dislocation at the level of the second cervical vertebra. These cases are excluded from discussion. In six of the remaining eleven cases the response of the tendon reflexes of the upper limbs varied, one or more being absent and the others present. In five cases this variation was present on both sides; in one case on one side only. Usually the variation was the same on both sides, but in Case XIII it differed on the two sides. The supinator jerk only was absent once; the supinator and biceps jerks were absent twice; the supinator and triceps jerks were absent twice; the biceps and triceps jerks were absent once; and the triceps jerk only was absent once. The remaining reflexes which were present were slight and not exaggerated, as with amyotrophic lateral sclerosis.

Though variation of response from one tendon reflex to another was found in a majority of cases, there was no evidence of a single localized lesion of the spinal cord as a characteristic feature of the type of case under review. The findings suggested rather the presence of a lesion extending through a considerable length of the spinal cord and varying in degree at different levels. Variations in the motor and sensory functions favoured the same conclusion and showed that a strictly localized lesion of the spinal cord was uncommon.

Nevertheless, variation in the response of the tendon reflexes from segment to segment was an important finding and of considerable help in relating the disability to a previous injury. In Case XIII it was the critical finding which drew attention to a possible traumatic origin of a condition which had been present for many years. The manner of involvement of the muscle groups of the upper limbs had the same effect. In the right upper limb the supinator and biceps jerks were absent and the triceps jerk was present; whereas in the left upper limb the supinator and triceps jerks were absent and the biceps jerk was present. In the right upper limb movements of the hand and wrist, supination of the forearm and flexion of the forearm were weak; whereas extension and pronation of the forearm were strong. In the left upper limb movements of the hand and wrist, pronation of the forearm and extension of the forearm were very weak; whereas flexion and supination of the forearm were strong.

The value of variation in the response of successive tendon reflexes in the upper limb suggested by Walshe and Ross (1936) has been confirmed. The lesion is not as a rule limited to the fifth cervical segment of the spinal cord, but may appear at one or more levels within the fifth to seventh cervical segments and even above or below those segments. The lesion may be most pronounced at any of these levels.

PATHOLOGY.

In the type of case under discussion direct pathological observations are not usually available. The clinical evidence does, however, point to the following conclusions. A lesion extending over several segments of the cervical portion of the spinal cord, usually above and below the fifth cervical segment and less often about the second cervical segment, is more common than one limited to a single segment. It is not necessarily uniform throughout its whole length, but may be more severe at two or more levels and less severe at levels between them. It may be more severe on one side of the spinal cord than on the other, though usually it affects the two sides in much the same

way. The pathology deduced from the clinical findings is thus of a type that is more likely to be produced by an abrupt stretch to the cervical cord by forcible flexion or extension of the cervical spine from a blow on the head. Consideration of the effects of stretch must, however, take into account the relative fixation of the spinal cord by denticulate ligaments and anterior and posterior spinal roots.

Plewes (1938) has described the pathological appearances in the spinal cord of a patient who had quadriplegia immediately after an accident associated with a fall on the head and who died eight days later. There was no evidence of fracture-dislocation of the spine either on X-ray examination or at autopsy. After removal of the posterior longitudinal ligament, which was intact, extreme flexion of the head caused the intervertebral disc between the bodies of the fourth and fifth cervical vertebræ to protrude two millimetres beyond the posterior edges of the bodies above and below. On the anterior aspect the spinal cord was marked by a transverse indentation and on the posterior aspect by a very slight bulging. In the substance of the spinal cord at this level a dark, reddish softening involved a large part of the transverse area, especially to the left and posteriorly. On the outer surface and in the outer fibrous layer of the dura there were collections of red blood cells, which were also present about the arterioles. The outer fibrous layer of the dura was folded and appeared to have been torn. Sections of the spinal cord at the level of the injury showed irregular cavities mostly in the back and side of the cord; evidence of acute degenerative change in most of the nerve cells; almost complete destruction of myelin sheaths and degeneration of the axones; and congestion of the small blood vessels with many loose red blood cells in the neighbourhood of the cavities and among the glial and nervous structures. There were no inflammatory changes. These findings suggested extrusion of the intervertebral disc with forcible flexion of the cervical spine as a factor in the causation of injury to the spinal cord without fracture-dislocation of the spine.

THE POSITION OF TRAUMA IN THE CAUSATION OF DISEASE OF THE SPINAL CORD.

The evidence outlined above suggests that progressive muscular atrophy, amyotrophic lateral sclerosis and syringomyelia which have followed upon injury and have been regarded as diseases of the spinal cord due to injury, are not really these conditions in the sense the terms are usually employed. The abnormal conditions and the disabilities found are actually the direct and remote effects of trauma which have produced a clinical picture resembling, in some cases only superficially, that of the diseases mentioned. When examined in detail the findings often differ from those of the diseases; examination of the circumstances of the accident reveals the occurrence of characteristic symptoms for a short time after the accident; and inquiry into the history shows that minor though characteristic symptoms have appeared from time to time between the injury and the onset of the disability. In Case XII transient symptoms had appeared after the original accident, similar symptoms had appeared from time to time during the twenty-two years from the accident to the onset of serious disability, and at operation arachnoidal adhesions with encystment of cerebro-spinal fluid were found about the part of the spinal cord affected. Actually diagnosis of the condition as one of the

diseases mentioned without recognition of a relationship to injury is more common than the acceptance of injury as an exciting cause of a definite disease as distinct from the effects of trauma of the spinal cord. For the suggestion that trauma of the spinal cord may prepare the ground in which other factors may become active, as in disseminated sclerosis, this study has provided no evidence.

SUMMARY AND CONCLUSIONS.

1. The effect of head injury upon the cervical portion of the spinal cord has been studied in thirteen cases.

2. Four cases of moderate injury to the cervical portion of the spinal cord with fracture-dislocation of the spine, six cases of minor injury to the cervical portion of the spinal cord without fracture-dislocation of the spine, and three cases illustrating the remote effects of such injury are described in detail.

3. The clinical features of the immediate and remote effects of injury to the cervical portion of the spinal cord following head injury are described.

4. The value of careful examination of the tendon reflexes of the upper limbs in the diagnosis of these cases, when they might otherwise be overlooked, has been confirmed.

5. On the evidence available it seems that disease of the spinal cord which has followed injury, may be actually a remote effect of injury simulating disease.

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Surgical Technique.

SPINAL ANÆSTHESIA: ROUTINE PROCEDURES.[1]

By Douglas Robb,
Auckland.

The object of this communication is to describe a practical system which has been arrived at after eleven years of active interest in the subject. No attempt is made to be comprehensive in referring to the many procedures advocated or to the different drugs employed. Maxson's recent book (1938) covers this ground, but even since its publication there have been a number of notable additions to the literature, so rapidly is the subject developing and so widely is this form of anæsthesia being practised.

Equipment.

Equipment is simple and can be compactly arranged for transport. I carry in the bag I take to private hospitals, with instruments for operations, a flat metal box, 16 by 9 by 3 centimetres, which contains practically everything necessary:

Two Labat's lumbar puncture needles (moderate thickness and rather blunt bevel).
One 20 cubic centimetre "Record" syringe.
Two 2 cubic centimetre "Record" syringes.
One fine hypodermic needle, three to four centimetres long.
Three 1 cubic centimetre ampoules of 10% "Stovaine".
Three 20 cubic centimetre ampoules of one in 1,500 "Percaine" solution.

In addition to these contents of the box, the theatre tray should also be stocked with: antiseptic solution for skin (coloured), for example, tincture of "Metaphen" or tincture of iodine; small rubber-capped bottle of local anæsthetic solution; containers with hot sterile water to warm ampoules; warm sterile water for syringes after sterilization. The anæsthetist should have at hand a sphygmomanometer and half grain ephedrine tablets for injection if necessary.

Principles.

Only two preparations are used. The 10% "Stovaine" solution is strongly hyperbaric, or denser than the cerebro-spinal fluid, and rapidly falls to the lowest part of the theca after injection. It is a strong solution, acts rapidly on the nerve roots, and in a very few minutes has become fixed and no longer diffusible if the position of the patient is altered. Anæsthesia is complete in three to five minutes from the time of injection, and lasts about forty-five minutes.

"Percaine" is a very potent drug, and acts strongly in a very weak solution. The one in 1,500 solution is hypobaric, or less dense than the cerebro-spinal fluid, but, inasmuch as the margin is slight, it is important to have the temperature of the solution as it is injected very close to 98·4° F. This "natural" solution of "Percaine" is the only genuinely hypobaric preparation for spinal anæsthesia. Preparations of other drugs, such as "Novocain", have been rendered hypobaric by the addition of another substance such as alcohol. This moiety diffuses rapidly, and there are doubts as to whether the solution thus artificially rendered hypobaric really behaves as a genuinely hypobaric solution does. The second unique quality of "Percaine" is the duration of its action. The one in 1,500 solution gives satisfactory anæsthesia for two hours, and stronger solutions last up to six or more hours.

[1] Accepted for publication on January 19, 1940.

Special methods were developed to make use of these properties of "Percaine". The principles were laid down by Howard Jones (1930) and elaborated by Harris and Rink (1937). Lake (1938), a collaborator of Howard Jones at the outset, has recently made an important modification for chest and upper abdominal operations. I have published two simple expositions of the subject (1932, 1938). Howard Jones relied on the volume of "Percaine" solution injected to reach the required level. He made the injection in the lumbar region, and used up to 18 cubic centimetres to reach the third dorsal nerve root in a big man. About 10 cubic centimetres were required to reach the tenth dorsal segment, and about eight for the twelfth. The injection was made with the patient in the lateral position, and the patient was at once placed in the ventral position, to allow the solution to float up and soak the dorsal roots. After five to ten minutes the patient was rolled on to his back, to soak the anterior roots and give muscular relaxation. The time that the patient spent in the ventral position was short or long according to whether loss of sensation was relatively less or more important in the particular case than muscular relaxation. The patient was left on the sound side with no turning at all if unilateral anæsthesia was required as in tibial osteotomy or nephrectomy.

Harris and Rink studied the rate of fixation of the "Percaine" to the nerve roots, finding it to be rapid at first and then tailing off to completion at thirty minutes. The greater part was over by ten to fifteen minutes. They foreshadowed Lake's achievement in diminishing the number of anterior roots affected, and thus the fall in blood pressure, to the bare minimum required.

Lake's modification for upper abdominal work (I have found it equally satisfactory for thoracic operations) seems to me a triumph of safety, simplicity and efficacy. He uses the same solution of "Percaine" as Howard Jones, and, by a cunning use of posture, anæsthetizes the second dorsal to third lumbar roots with half the quantity of solution, half the constitutional effects (on circulation and blood pressure), half the "turnings" of the patient, and with equal efficacy. This method to my mind displaces completely both the elaborate air replacement girdle anæsthesia method of Kirschner and the "less safe and less precise" (Lake) upright convection method of Etherington-Wilson.

The deportment of surgeon, assistants, nurses and staff in the theatre is of great importance in spinal anæsthesia. Quietness in movement and handling of instruments, a minimum of bustle and talking, and extreme discretion in discussion of the findings at operation and the prognosis are necessary. The patient is usually given a sedative injection beforehand, and may sleep quietly throughout, but he may be listening to everything and even succeed in seeing a good deal.

Low Spinal Anæsthesia.

Here the anæsthesia is limited to the lower sacral segments, and is admirable for such operations as: dissection of pilonidal sinus; removal of the coccyx; operations on the lower part of the rectum, anal canal, ischio-rectal fossa, perineum, cervix, urethra and prostate. The sensation of distension of the bladder remains while the trigone and sphincters are numb and relaxed, so that dilatation of stricture and cystoscopy may be readily carried out.

A preliminary injection of one-sixth of a grain of morphine and one one-hundred-and-fiftieth of a grain of hyoscine is usually sufficient. The patient sits up and leans slightly forward (the "sitting bull" position of Maxson). A wheal is raised between the fourth and fifth lumbar spines with the local anæsthetic, and a track deep to this is infiltrated also. The lumbar puncture needle is inserted in the mid-line, and when the theca has been passed and fluid seen to run out on withdrawal of the stylet, the "Stovaine" solution is injected from a previously loaded two cubic centimetre syringe; 0·4 cubic centimetre is used for sacro-coccygeal, ano-rectal and perineal operations. 0·5 cubic centimetre for the cervix and for cystoscopy. Two minutes only are required for the solution to sink and become fixed to the nerve roots, and it is a good plan to leave the needle (stylet replaced) in position for that period. On withdrawal of the needle the patient may be placed on his back or in the lithotomy position, and the operation begun.

Constitutional symptoms are absent. The fall of blood pressure is either nil or so slight as not to require ephedrine or other treatment.

For the operations mentioned this procedure is admirably safe, quick and efficient, and may be preferred to the more tedious and less certain procedures of injection via the *hiatus sacralis* or other sacral foramina. The only post-operative sequel, in fact, the only disadvantage the method has in my experience, is the risk of "spinal" headache.

Medium Spinal Anæsthesia.

In medium spinal anæsthesia, which extends up to the umbilicus, a considerably larger field has to be anæsthetized and some fall of blood pressure is to be expected. The premedication I use regularly is this: 120 minutes before spinal puncture, morphine grain one-sixth and hyoscine grain one one-hundred-and-fiftieth; 60 minutes before spinal puncture, repeat the morphine grain one-sixth and the hyoscine grain one one-hundred-and-fiftieth; 30 minutes before spinal puncture, ephedrine grain one-half; 10 minutes before spinal puncture (if the patient is not asleep), repeat morphine grain one-sixth and hyoscine grain one one-hundred-and-fiftieth. More ephedrine may be given effectively during the operation if necessary.

"Percaine" (one in 1,500 solution) is used, and the injection is made between the fourth and fifth lumbar spines with the patient in the lateral position. Eight to ten cubic centimetres are injected without withdrawal of more than a few drops of cerebro-spinal fluid. The patient is at once rolled on to the face, and the curves of the back are sighted against a horizontal line on the wall. The table is then tilted so that the segment of the theca extending from about the tenth dorsal vertebra to the upper sacral vertebræ lies at a slight elevation above the segment opposite the remaining dorsal vertebra. Sometimes a pillow must be placed under the abdomen in order to diminish for the time being the lumbar lordosis. The solution thus floats up into the segment first mentioned. In most cases this means placing the head end of the table 5° to 10° down, but individuals vary so much in the stoutness of abdomen and shape of spinal curves that the segments should always be visualized as described and the table tilted accordingly. After five to ten minutes in this position the patient is returned to the dorsal position. The table is left as before, and as soon as required by the surgeon the head end is lowered still further into the Trendelenburg position. The operation may be begun fifteen to twenty minutes after the injection of the "Percaine".

With the preliminary use of ephedrine, fall of blood pressure and other unpleasant symptoms are rarely encountered. The quantity of "Percaine" (eight to ten cubic centimetres) is not large. Both anæsthesia and relaxation are admirable, and hysterectomy, suprapubic prostatectomy and other deep pelvic operations are greatly facilitated. The bowel is generally contracted, and can easily be packed away out of the pelvis.

Unilateral anæsthesia, as for herniotomy and osteotomy, can be obtained if desired by keeping the patient on the sound side for ten minutes after injection, with the slope of the lower part of the theca and its relation to the upper part as already described.

High Spinal Anæsthesia.

After some years of great satisfaction with the Howard Jones technique for high spinal anæsthesia (for upper abdominal and thoracic operations), I have lately given it up for Lake's modification and had even greater satisfaction.

The area between the second dorsal and third lumbar roots is anæsthetized in this way. The patient lies face downward on the table, pillows are placed under his chest, and the table is tilted so that the normal thoracic kyphosis lies with the seventh dorsal spine (roughly the angle of the scapula) at its summit. This is best checked by sighting the contours of the back against a horizontal line on the theatre wall. From the summit, both the upper dorsal and cervical, and the lower dorsal and lumbar parts of the spine slope downwards. The puncture is made between the second and third lumbar spines with wheal and central track as usual. Lake uses a special needle with a solid point and lateral eye, but I find it satisfactory simply to keep the bevel of an ordinary needle facing upwards. On demonstration of the presence of fluid (aspiration is sometimes needed), a ten or twenty cubic centimetre syringe containing six to nine cubic centimetres of "Percaine" (one in 1,500) is connected, and the solution is slowly injected in a continuous stream, one to two minutes being taken for the injection. The pool or bubble of "Percaine" reaches the summit of the curve in the theca, and is allowed to soak the posterior roots therein for five to ten minutes. On return to the dorsal position the Trendelenburg slope may be used at once.

Premedication is exactly the same as described for medium spinal anæsthesia, and the ephedrine need not usually be repeated during the operation. Nine cubic centimetres only are used for a tall heavy man, as little as six cubic centimetres being enough for a short slight woman.

In upper abdominal operations, for example, gastrectomy and common duct operations, spinal anæsthesia must always be completed by blocking the vagi as they enter the abdomen on the œsophagus. The infiltration of twenty cubic centimetres of one in 1,500 "Percaine" solution with adrenaline into the periœsophageal tissues, after the abdomen has been opened, achieves this. The left forefinger finds the œsophagus and a 23 centimetre needle, whose point can be advanced beyond the end of a rigid guard, is used under guidance of the left index. The procedure is very similar to the injection of the splanchnic plexus after the abdomen is opened under local anæsthesia.

For nephrectomy and inguinal herniotomy, where a more limited unilateral zone only need be anæsthetized, centred around the twelfth dorsal segment, a similar procedure can be used. The patient lies in the lateral position on the sound side, pillows are placed under the lower ribs and the table is tilted so as to make a curve convex upwards, with its summit at about the tenth dorsal spine. The puncture is made between the third and fourth lumbar spines, and six or seven cubic centimetres of "Percaine" are floated up to the top of the curve. Little change of posture is needed in nephrectomy. In herniotomy the dorsal position may be assumed in five to ten minutes.

In thoracic surgery most procedures are readily carried out with spinal anæsthesia, with the exception of apical thoracoplasty and apicolysis. The cough reflex is retained and this is a great advantage. A gas machine is necessary in addition when positive pressure through a face-piece is required. The zone anæsthetized is the same as in upper abdominal work, and either the ordinary Lake procedure or a lateral one may be used. I have had better results from injections with the patient in the ventral position with the side to be operated on slightly raised, than in the fully lateral position, though theoretically this is better. Resections of ribs from the fourth downwards, as in thoracoplasty, and exploratory thoracotomy with lobectomy, repair of diaphragmatic hernia (phrenic injected and crushed also), and removal of hydatid cyst, except at the pulmonary apex, have all proved easy with spinal anæsthesia.

In infants I have used spinal anæsthesia with "Percaine" for Rammstedt's operation and for intussusception and other abdominal conditions in bigger babies. In small babies one cubic centimetre of "Percaine" solution, at twelve months 1·5 cubic centimetres, and at eighteen months two cubic centimetres have proved satisfactory for abdominal explorations. A two cubic centimetre syringe and fine hypodermic needle are used, and the puncture is easily made between the first and second lumbar spines. Postures similar to those in adults are then carried out. The literature seems to be singularly barren of details of dosage of "Percaine" for infants and children. In older children I have performed osteotomy and abdominal operations under spinal anæsthesia, but do not consider children good subjects for this procedure.

Complications and Sequelæ.

Headache, common to all occasions of lumbar puncture, is the only frequent and considerable sequel to spinal anæsthesia, and it must be conceded to be a defect in the method. Its occurrence does not appear to be related to size of needle, number of punctures, drug injected, nor type of operation. That it is due to hypotension following leakage of fluid through the hole in the theca seems denied by the absence of similar headache on other occasions when cerebro-spinal fluid leaks, for example, after decompression and laminectomy. I regard it as a reflex nervous effect. Many remedies are confidently advised for it, but its relief is difficult. Keeping the patient horizontal without a pillow seems to help more than anything else. The headache may be very severe, but always seems to clear up completely usually within ten to fourteen days.

Post-operative distension of the abdomen and retention of urine occur no more frequently after spinal than general anæsthesia and are tractable on ordinary lines with "Doryl" and hypertonic saline solution injected intravenously if required. Post-operative pulmonary complications are similarly about equal in incidence, probably because they are often thrombotic and embolic in origin, and are attributable in part to the immobility of the abdominal wall.

I have been fortunate in not encountering any of the other nervous system sequelæ so freely listed by the neurologists.

A point I always emphasize in the nursing of these patients immediately after operation is the need for care with radiant heat and hot-water bottles on account of the prolonged anæsthesia.

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Case Reports.

ENDOMETRIOMA OF THE UMBILICUS.[1]

By I. Douglas Miller,
Sydney.

The patient was a young woman who complained of a tumour present in the umbilicus for about two years. It used to become large and tender and blue at menstrual periods, and latterly would burst and bleed. A diagnosis of endometrioma of the umbilicus was made.

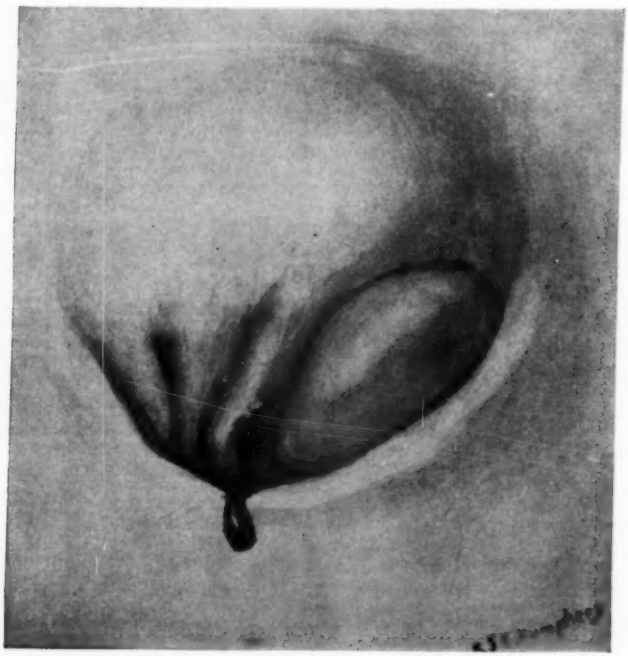

Figure I.

At operation the pelvic organs were found to be normal. The tumour was excised. To the naked eye the cut surface of the tumour looked rather like cavernous tissue. Histological examination revealed typical normal endometrial tissue.

[1] Accepted for publication on April 15, 1939.

MALIGNANT DISEASE OF LUNG TREATED BY PNEUMONECTOMY.[1]

By Douglas Robb,
Auckland.

Mr. S.D., a Russian Jew, fifty-one years of age, referred by Dr. Chisholm McDowell, had cough, expectoration and hæmoptysis for eight months. The onset was not clearly described. He had been treated for some months in another hospital without improvement, as though he were suffering from chronic lung abscess. Bronchoscopic drainage had been used.

Radiologically there was a cavity about three centimetres in diameter situated posteriorly and underlying the angle of the right eighth rib. Around this was an area of infiltration, more marked towards the hilum. There was no fluid level in the cavity. The sputum was muco-purulent, at times tinged with blood, and measured from eight to ten ounces a day. The cough was violent and distressing.

External drainage was decided on. Ten centimetres of the eighth and ninth ribs, centred at the angles, were resected, with the eighth intercostal bundle. The smooth area was packed with an iodine swab. A fortnight later an opening was made into the abscess cavity. Not much pus was found, but the lung tissue was very friable and easily broken down. Some pus drained through this wound, but little difference was noted in the amount of sputum or violence of coughing. The wound steadily progressed towards healing and the sputum slowly increased.

Two months after the abscess was opened, bronchoscopy by Dr. Hardie Neil failed to reveal any growth in the air passages. The examination was difficult, and the tree seemed to be narrowed and distorted below the branching of the bronchus to the upper lobe.

A further attempt was made at external drainage by the removal of a portion of the seventh rib. The cavity was now found to be very large, but biopsy of the walls revealed inflammatory tissue only. Again the wound progressed rapidly towards healing and the sputum increased.

Radio-opaque oil was run into the sinus, and showed a cavity now in the upper lobe as well as the lower lobe, with increased density in the hilar region. The general condition was still fairly good. The temperature subsided to normal after each interference. There was marked clubbing. With the diagnosis of chronic lung abscess, pneumonectomy was advised as being the only hope, and this was carried out four months after I had first seen the patient and twelve months after onset of symptoms.

The operation was carried out at the Mater Hospital under gas and oxygen anæsthesia induced by Dr. A. H. Kirker. The seventh rib forwards from its gap was resected and the chest was opened. The whole lung was adherent, lightly over the lower lobe, densely over the region of drainage and the upper lobe. It was freed all round and two Roberts-Nelson tourniquets were applied round the hilum. Indurated lung tissue was felt posteriorly near the tourniquets, and was later cut through, but no evidence of glandular or other growth was noted in the mediastinum. The cuff of lung tissue was sutured in mattress fashion with thick silk, and the first tourniquet was taken off. A second similar suture controlled all bleeding when the second was loosened, except for one vessel on the upper aspect, which was separately secured. There had been considerable loss of blood from the stripping of the lung, and shock was severe. However, after receiving a pint of blood the patient recovered very well, and although another pint of blood was given on the third day (incidentally nearly killing the patient with subsequent reaction), no further trouble with the circulation was encountered.

The wound was closed and the cavity lightly packed with six Macfarlane rolls of gauze previously impregnated with cod liver oil (three parts) and "Vaseline" (one

[1] Accepted for publication on October 26, 1939.

part). The ends of these were led out of the front end of the incision, and they were all easily removed on the tenth day, being left undisturbed until that time. There was a remarkable absence of toxæmia throughout the convalescence, in spite of the enormous raw cavity. This I attributed largely to the cod liver oil and "Vaseline" packing, the mechanism resembling that of the Winnett-Orr treatment of osteomyelitis. The discharge of pus was fairly profuse, but the temperature scarcely rose above 99° F. On the twenty-first day a large slough containing the ligatures came away through the wide opening at the anterior end of the wound, and about the same time it became clear that there was a large bronchial fistula.

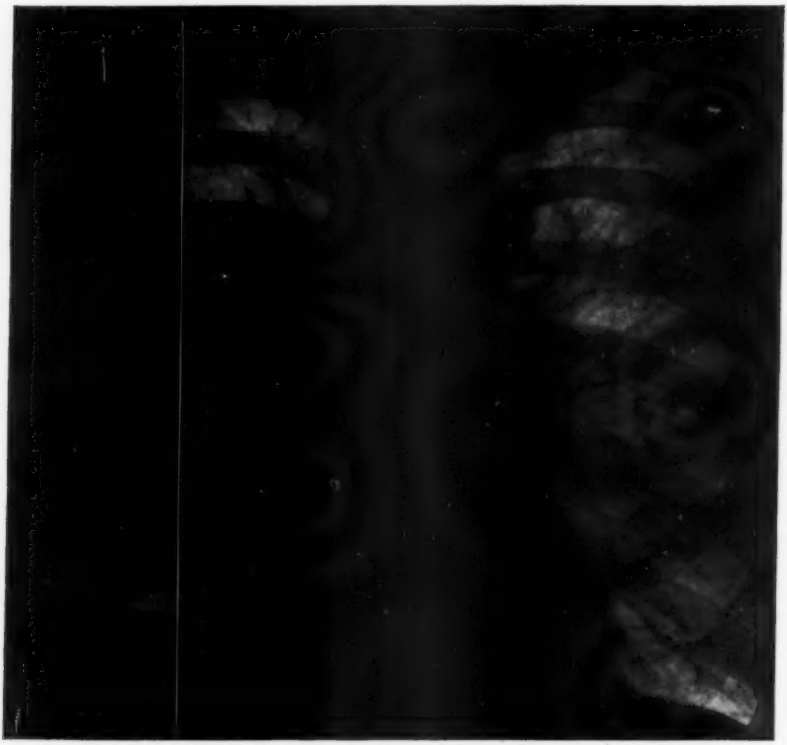

FIGURE I. Showing appearance after posterior drainage and before pneumonectomy. Wide infiltration in the middle zone of the right side with small cavity.

The specimen was examined by Dr. E. F. Fowler. Apart from the cavities known to exist there was slight bronchiectasis. The indurated tissue cut through near the hilum proved to be malignant. Dr. Fowler wrote: "For the most part the tumour is composed of solid masses of malignant squamous epithelium; there are a few areas showing an adeno-carcinomatous arrangement." In view of the well differentiated appearance of the tumour, its fairly long history, and the absence of macroscopic origin in a large bronchus and of metastases in the mediastinum, it was hoped that possibly with the slough the last portion of malignant tissue had come away.

The only other difficulty in the early convalescence was pharyngeal and laryngeal mucus. This distressed the patient greatly through inability to raise the sputum. Much help was afforded by Dr. Hardie Neil, who aspirated the pharynx, larynx and trachea

on several occasions. Later the mucus apparently fell through the fistula into the chest.

Thirty-one days had passed since the operation. The patient had been apyrexial for a week, the pleural cavity was clean in appearance though still discharging, the sloughs were safely away without the slightest hæmorrhage, and the patient was looking a new man. Even the clubbing was disappearing. A profuse hæmorrhage into the chest

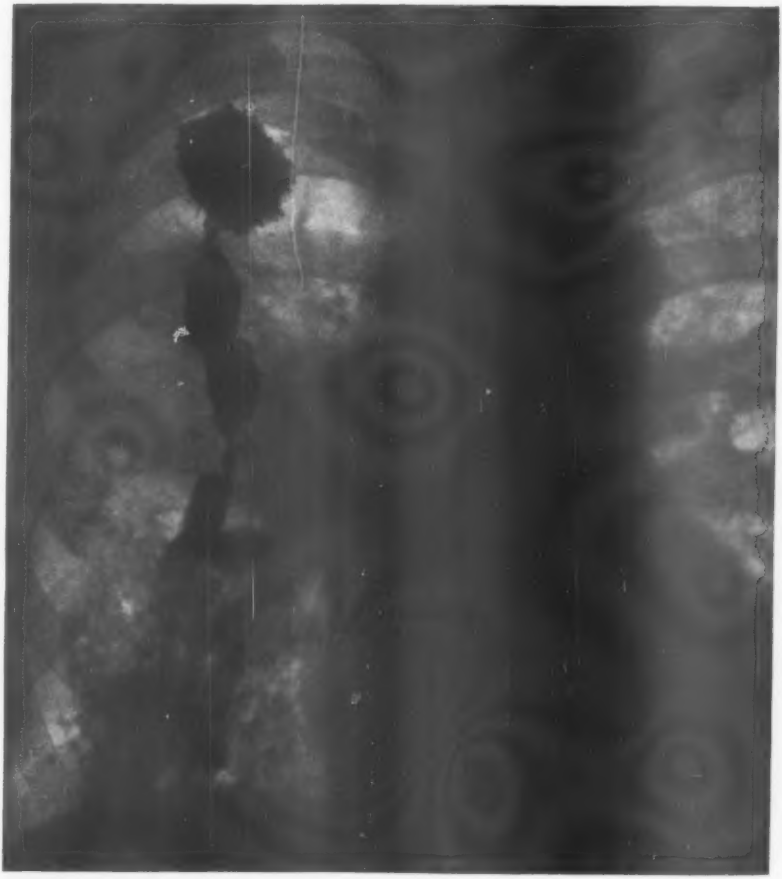

FIGURE II. Showing cavities injected with opaque oil through external drainage. The upper lobe contains the cavity.

occurred, and he nearly died. Eighteen hours later a pint of blood given by the drip method improved him greatly, but two days after the first a second hæmorrhage occurred and he died.

Post-mortem examination revealed a smooth and healthy pleural cavity, not greatly diminished in size. The two bronchial openings (upper and lower lobe main bronchi) on the mediastinum were smooth and inclined to close in. There was still some necrotic tissue around the stump, and induration was felt to extend up from the stump

under the mediastinal pleura. The right pulmonary artery was gaping, and had been the source of the hæmorrhage. Sections of this indurated tissue, and of necrotic tissue closely adjacent to the gaping pulmonary artery, revealed squamous epithelioma with a good deal of necrosis in each case.

FIGURE III. Showing the chest after pneumonectomy.

The points of interest arising out of this case are: 1. A malignant basis for a chronic lung abscess in the middle-aged should always be suspected, and is sometimes difficult to establish. 2. The growth was slow in progress, relatively benign and, in spite of discouraging radiological appearances, not far beyond the possibility of radical removal. This was so in spite of the fact that a surgical technique more suitable for a non-malignant condition was used. 3. Light packing of the cavity with cod liver oil and "Vaseline" in gauze, allowing support, diminution of early post-operative toxæmia, easy removal, and less distressing interference with the wound in the first few days, proved satisfactory. 4. Aspiration of the pharynx, larynx and trachea in the early days after operation to remove mucus was grateful to the patient.

The X-ray films were taken by Dr. F. J. Gwynne at the Mater Hospital.

LEIO-MYOMA OF THE STOMACH: A REPORT OF TWO CASES.[1]

By DAVID WHYTE,
Wellington.

MYOMA of the stomach is a rare tumour. Between 1907 and 1927 myoma accounted for ten out of twenty-seven innocent tumours removed by operation at the Mayo Clinic.[1] The incidence of all benign as compared with malignant tumours of the stomach is

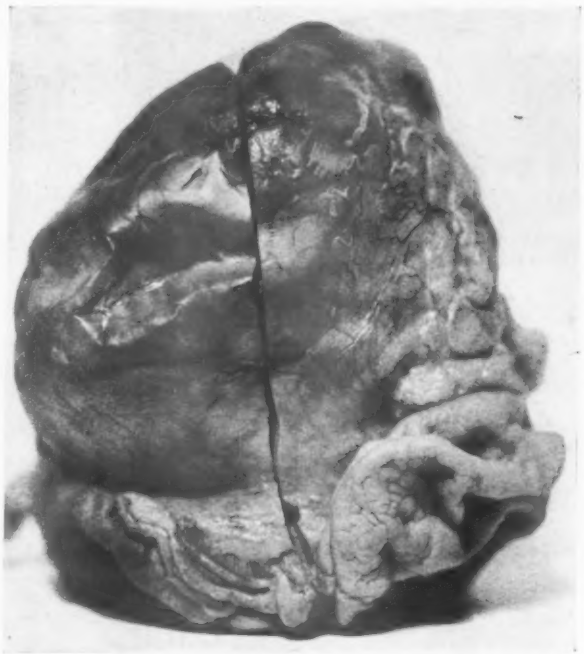

FIGURE I. Myoma of stomach with adjacent healthy stomach wall.

given by Eusterman, Balfour and the Mayo staff[2] as one in two hundred. R. P. Rowlands, while surgeon to Guy's Hospital for twenty-five years, removed only three innocent tumours of the stomach, of which two were myomata, and he has written two excellent accounts with references of this subject.[3][4]

Sir Louis Barnett in 1924 reported a New Zealand case featuring gastro-duodenal intussusception.[5]

[1] Accepted for publication on October 4, 1938.

Most innocent tumours of the stomach develop in the pyloric segment and project into the cavity. The first tumour here reported occurred high up on the greater curvature and projected away from the stomach; the second tumour occurred in the cardiac portion of the stomach and projected into the stomach.

FIGURE II. Complete hemisection of myoma of stomach (Case I). At the upper margin a defect due to a penetrating ulcer is shown.

FIGURE III. Ulcer of stomach penetrating into a myoma (Case I).

Case I.

D.B., aged fifty-three years, male, a labourer, was admitted to Wellington Hospital to a medical ward on February 24, 1938. Eight years previously he had first experienced indigestion, for which he consulted a doctor. He was given some medicine and was relieved for one year. Indigestion recurred occasionally for a year and a half, then

became worse, and he obtained relief by induced vomiting. Two years before his admission to hospital he started taking Maclean's powder, and found this useful. He had never been really free from symptoms for five and a half years. He might be free of pain for two or three days, then a violent pain would occur an hour after food, and he would make himself vomit. On January 3, 1938, he had a fainting attack, and lay on

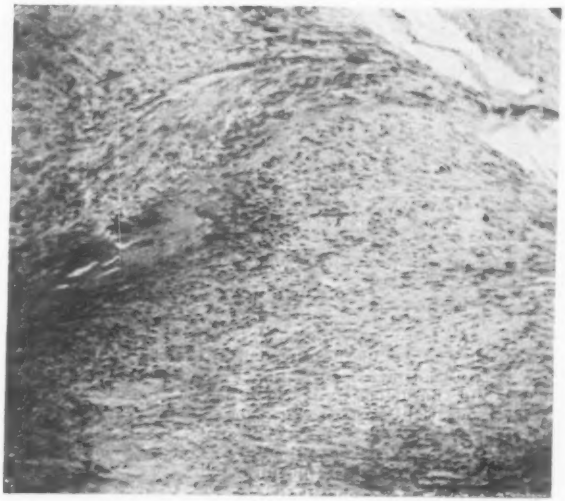

FIGURE IVA. Photomicrograph of myoma of stomach (Case I). The tumour has a regular spindle-celled structure. (Low power magnification.)

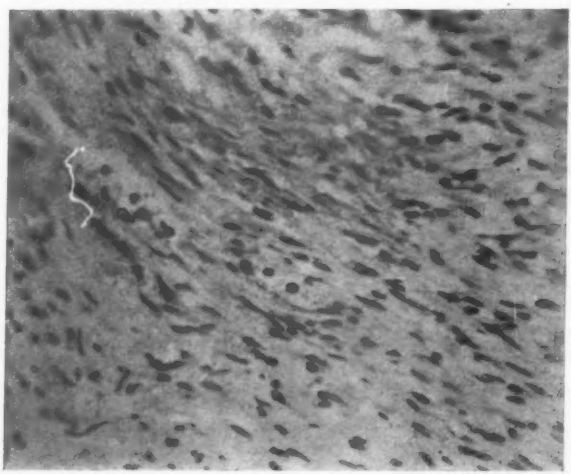

FIGURE IVB. Photomicrograph of myoma of stomach (Case I). A high power magnification of Figure IVA.

his bed sweating. This day he vomited a little red blood; next day, and for the following two weeks, his motions were tarry. During the next four or five weeks the stools were dark, but not tarry as at first; he became gradually weaker.

On admission to hospital he was pale and well nourished. His systolic blood pressure was 150 and his diastolic pressure 100 millimetres of mercury. Blood examination showed that the erythrocytes numbered 3,260,000 per cubic millimetre; the hæmoglobin value was 47%. The blood did not react to the Wassermann test. Occult blood was present in the stool for two weeks after admission, and was again noted after a further interval of nine days.

A fractional test meal showed a low acid curve and slow emptying of the stomach. The resting juice amounted to five cubic centimetres, was free from starch, blood bile and lactic acid, and showed 2% free hydrochloric acid and 16% total acid.

X-ray examination by screening after a six-hour meal revealed a filled crater high up on the greater curvature.

A blood transfusion of six ounces of citrated blood was given soon after his admission. His appetite was good and he had no pain. His condition continued to improve.

On April 2, 1938, blood examination revealed 4,380,000 erythrocytes per cubic millimetre and a hæmoglobin value of 74%.

On April 5, 1938, operation was performed. Anæsthesia was obtained by infiltration block of the abdominal wall with 1% "Novocain", supplemented with ether by inhalation.

A dark red circumscribed fluctuant tumour was found arising from the greater curvature of the stomach, high up and extending into the left border of the gastro-colic omentum. A clamp was applied to the stomach and the tumour was excised with an ample margin (about two centimetres) of stomach wall. The stomach was repaired by suture in two layers, and the defect in the gastro-colic omentum was closed. Recovery was uneventful, and the patient was discharged from hospital on April 27, 1938, on a full diet.

On June 20, 1938, he was very well and free from symptoms. He had gained fourteen pounds in weight since leaving hospital.

A pathological report of the specimen was as follows:

"The specimen weighs 156 grammes (five and a half ounces). Protruding from the wall of the stomach is an ovoid tumour of maximum diameter three inches and the size of a small orange. The peritoneum is tightly stretched over the surface of the tumour, which is smooth. To the naked eye there is no infiltration of the peritoneum by the underlying mass. The substance of the growth is firm and white, and shows no areas of hæmorrhage or necrosis. In that part of the mucosa of the stomach corresponding to the pedicle of the tumour is a penetrating ulcer having a crater about one centimetre deep. The appearances suggest that this is a chronic peptic ulcer arising at the site of a pre-existing tumour.

"Microscopically the mass is composed of bundles of spindle cells with elongated nuclei. The cells are regular in shape and staining properties. There is an appearance of bundles of fibres cut in cross-section alternating with longitudinal sections that is typical of a myoma. Scanty well supported blood vessels are present. The tumour extends right to the mucosa of the stomach, but there is no infiltration of the neighbouring coats of the stomach. In no part of the sections is there any appearance of malignancy. The specimen is a leio-myoma."

Case II.

D.S., aged fifty-one years, a male, a clerk, was admitted to Wellington Hospital to a medical ward on January 28, 1938. That evening, whilst at work, he felt nauseated and began to sweat; he made himself sick and vomited twice, at first food and dark blood, then food and red blood. The blood in all was estimated at eight ounces. On admission he was cold and pale; his pulse rate was 110 per minute. He had never suffered from indigestion, his appetite was good, and he had not lost weight. He appeared to be young for his years.

There was no further hæmatemesis. Occult blood was noted in the stools till eleven days after admission.

On January 29, 1938, blood examination showed that the erythrocytes numbered 5,700,000 per cubic millimetre; the hæmoglobin value was 90%. The blood did not react to the Wassermann test.

On February 19, 1938, an X-ray examination by opaque meal was carried out by Dr. P. D. Cameron. There was no six-hour residue. There was a peculiar large rounded filling defect in the upper part of the *pars media*. No mass was palpable. The remainder of the stomach and the duodenal cap were normal. The appearances were thought to suggest a tumour mass in the upper part of the stomach, possibly not malignant. A diagnosis of a polypoid condition was suggested.

On March 4, 1938, gastroscopy was performed by Dr. Alan Tennent. A polypoid mass was seen two-thirds of the distance up the posterior surface of the stomach.

The patient was discharged from hospital well on March 5, 1938, and was readmitted on December 5, 1938, having been free of signs and symptoms in the interval.

On December 8, 1938, gastroscopy was performed. The polypoid mass seen on the previous occasion was revisualized almost on the greater curvature in the *pars media*. There was some superficial ulceration. The mass did not appear to have increased in size, and looked like a simple pedunculated polypus.

On December 12, 1938, operation was performed by Mr. H. K. Corkill. Inhalation anæsthesia was induced by ethyl chloride and open ether. From the posterior surface of the stomach, towards the upper part of the lesser curvature, a polypoid mass, the size of a walnut, with a wide base, projected into the lumen. There were numerous hard glands in the mesentery, one of which was removed for biopsy. The peritoneal surface of the affected part of the stomach appeared to be infiltrated. The stomach was opened, the growth was inspected and partial gastrectomy was carried out between clamps. Convalescence was uneventful.

The following pathological report was made by Dr. J. O. Mercer:

"At the cardiac end of the stomach and close to the margin of the excised specimen is a firm, well

FIGURE V. Complete hemisection of a myoma of stomach (Case II).

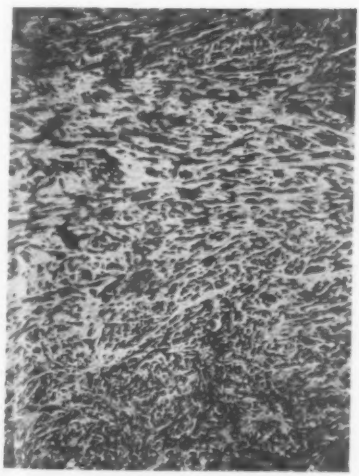

FIGURE VIA. Photomicrograph of myoma of stomach (Case II). (Low power magnification.)

FIGURE VIB. Photomicrograph of myoma of stomach. A high power magnification of Figure VIA (Case II).

encapsulated, spherical tumour three centimetres in diameter. This tumour projects into the cavity of the stomach. The mucosa over the surface of the tumour is irregularly and superficially ulcerated. The tumour lies in the submucosa. There is some dimpling of the peritoneum over the tumour and in its neighbourhood there are several small fibrous plaques on the peritoneum and several calcified glands. The naked-eye appearances suggest that the tumour is benign.

"Microscopically the tumour has all the characteristic appearances of a leio-myoma. The cells forming the tumour are spindle shaped with elongated nuclei. These cells occur in bundles and the microscopic field shows some of these running longitudinally, while others are cut in cross-sections.

"The tumour has a fibrous capsule. There is no evidence of malignant change. The tumour is a leio-myoma of the stomach."

Summary.

1. Two cases of myoma of the stomach are reported.

2. Hæmorrhage determined admission to hospital in both cases—in the first case after symptoms suggestive of ulcer had existed for eight years, in the second case without any previous symptoms.

3. In the first case the tumour occurred high up on the greater curvature of the stomach and projected into the gastro-colic omentum. An ulcer extended through the stomach wall into the tumour. In the second case the tumour occurred in the cardiac portion of the stomach and projected into the lumen.

4. Treatment was carried out by surgical removal and resulted in recovery.

Acknowledgements.

I am indebted to Dr. J. O. Mercer, of the Wellington Hospital, for the pathological work, and to Dr. E. Stevenson-Wright, of the same hospital, for the photography in the first case; to Mr. H. K. Corkill for permission to record the second case, and to Dr. N. Hill for the photography in the second case.

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(2) Eusterman and Balfour: "The Stomach and Duodenum", 1936, page 547.

(3) R. P. Rowlands and P. Turner: "Operations of Surgery", Eighth Edition, 1937, Volume ii, page 237.

(4) R. P. Rowlands: "Myoma of the Stomach", *Guy's Hospital Reports*, Volume lxxiv, 1924, page 64.

(5) L. E. Barnett: "A Case of Myoma of the Stomach with Gastroduodenal Intussusception", *The British Journal of Surgery*, Volume xii, 1924-1925, page 615.

LARGE DUODENAL DIVERTICULUM TREATED BY ANASTOMOSIS TO THE JEJUNUM.[1]

By A. J. OPIE,
Lismore, New South Wales.

THE patient, a somewhat tall thin nulliparous woman, was first seen in 1928. She was then aged twenty-two years, and complained of acute attacks of pain commencing in the right side of the upper part of the abdomen and passing across the epigastrium

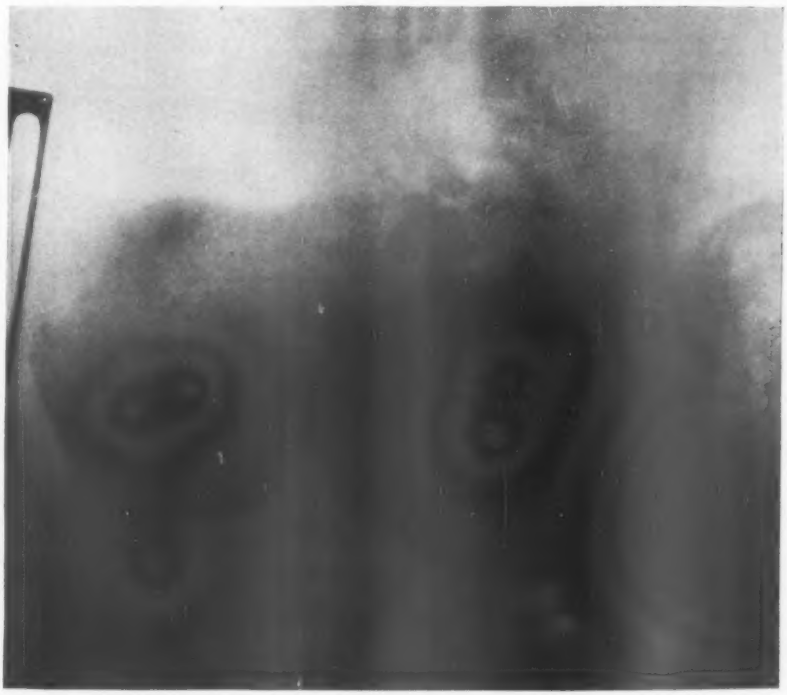

FIGURE I. Skiagram taken half an hour after meal. Large duodenal diverticulum is clearly visible (taken in 1928).

to the left side. These attacks lasted "a minute or two", "doubled her up", and she found that greatest ease was obtained by forcibly drawing the knees upwards towards the chest. She felt quite well between the attacks of pain, which occurred as often as

[1] Accepted for publication on October 2, 1939.

three times a day and occasionally at night. She experienced nausea, but no vomiting. Her appetite was good and aperients were required only occasionally. Common symptoms of digestive disturbance were absent. She stated that since childhood she had been subject to severe bilious attacks accompanied by headache, vomiting and the production of "stars before the eyes". No pain in the abdomen occurred during these bilious attacks.

General medical examination revealed no abnormality until a barium meal disclosed a large duodenal diverticulum. Five hours after barium meal had been taken the barium in the diverticulum had sufficiently diminished in density to display a triangular-shaped foreign body in its cavity. This was cartilaginous in nature and measured 4·0 by 2·0 centimetres.

FIGURE II. Skiagram taken in 1933. Arrow points to site of anastomosis.

The severity of the attacks was such that operation was decided upon. Through a right upper paramedian incision a very large duodenal diverticulum arising from the lower portion of the second part was displayed. Its position and size were such that removal was deemed inadvisable.

An anastomosis was therefore made between the lowest portion of the diverticulum and the highest portion of the jejunum. The foreign body was removed. Relief from the attacks of pain resulted. The bilious attacks became much less severe, headache and flashes of light occurring, but no vomiting. Each year for ten years after the operation I have made an examination with the barium meal. The stoma still functions well, but there appears to be little if any diminution in the size of the diverticulum.

HYDATID CYST OF LUNG WITH EXTRAORDINARY COMPLICATIONS.[1]

By Douglas Robb,
Auckland.

Mr. P.K.D., aged sixty-five years, was referred to me by Dr. Chisholm McDowell on account of severe hæmoptysis requiring blood transfusion. Temporary recovery was followed by further small hæmorrhages until a big hæmorrhage led to a second transfusion. On this occasion it was clear for the first time that some at least of the blood was vomited, and portions of grey material like mushrooms suggested that clots

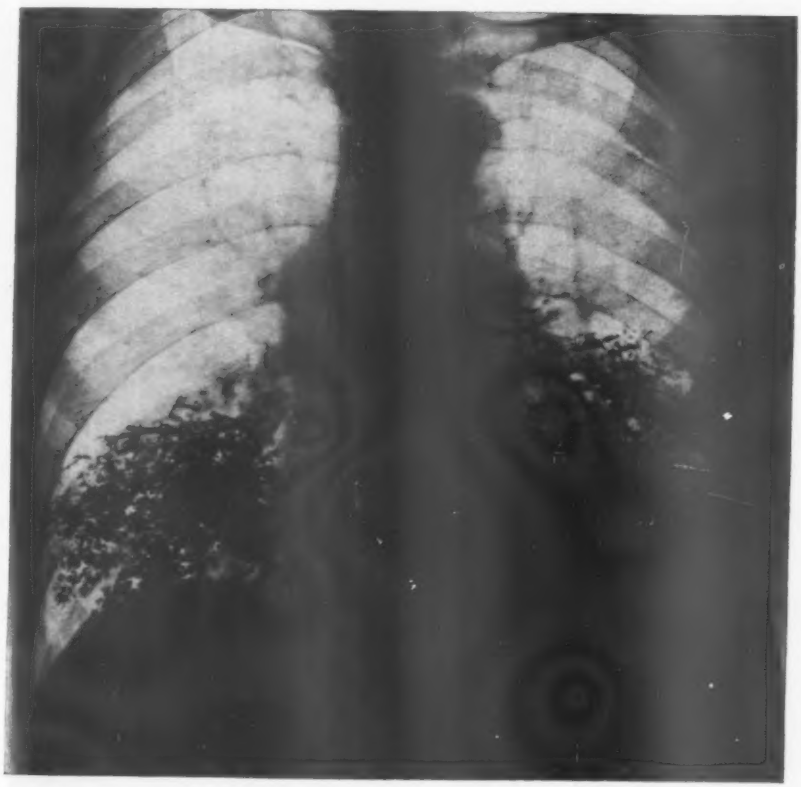

Figure I. Bronchogram showing left basal bronchiectasis and cavity filled with lipiodol in the neighbourhood of the diaphragm.

[1] Accepted for publication on October 26, 1939.

had been in contact with gastric juice. The abdomen was opened as a last resort, but the patient stood up to the exploration badly. Nothing was done, and he died soon afterwards.

The history was that fifteen months before his death he had suddenly coughed up a large quantity of clear fluid with material like grape skins. This membranous material had persisted in the expectoration for six months and then ceased. He was a photographer and previously had enjoyed good health. From the bronchiectasis subsequently revealed, there is some doubt whether a chronic cough was present before this occurrence. It is probable, though not certain, that the bronchiectasis had

FIGURE II. Ascending bronchogram with barium from the stomach. 1 = œsophagus, 2 = stomach, 3 = cavity in the base of the left lung, 4 = dilated bronchi of the base of the left lung filling with barium.

been present for several years. After the membrane ceased coming up he maintained fairly good health, though with a persistent muco-purulent expectoration, until he started to cough up blood, as already described, three weeks before his death.

After the first rupture of what was almost certainly a hydatid cyst, X-ray examination revealed a large radio-opaque ring, about five inches in diameter, in the region of the left dome of the diaphragm. This was interpreted as being due to calcification of the pericyst, and as indicating the considerable age of the cyst. The diaphragm was indistinguishable, and the cyst was thought to be seated in the left lobe of the liver, with rupture through the diaphragm into the bronchus. Bronchograms by C. McDowell three months before the patient's decease revealed gross bronchiectasis of all bronchi to the lower lobe of the left lung, and a cavity which readily filled with opaque medium amongst them. The cavity was about two inches by one inch, and again it was not clear whether it lay above or below the diaphragm. When it was established that part of the blood was being vomited, a barium meal

was given, and the medium was easily manœuvred into the cavity and thence into the dilated bronchi. Thus an ascending bronchogram was made with barium from the stomach (Dr. F. J. Gwynne).

The specimen *post mortem* showed that the cavity lay in the lung. It was smooth and epithelialized and contained a mushroom-shaped clot, together with several calcified plaques almost loose. Four or five large openings communicated with antero-lateral bronchi, grossly dilated, whereas the posterior basal bronchi, also grossly dilated, led

FIGURE III. Photograph of specimen.

to an infiltrated and œdematous area of lung. There was also a hole about half an inch in diameter leading through an adherent diaphragm to the fundus of the stomach. The left lobe of the liver, the spleen and the omentum were densely adherent around this opening, but not otherwise involved.

Here, then, was a man who died of hæmorrhage from the residual cavity of a hydatid cyst of his lung, after successfully evacuating the whole of its fluid and membrane via the bronchi. In the last three weeks of his life the cavity communicated with his stomach, so that he could have vomited up lipiodol which had been introduced into his bronchial tree and passed through his diaphragm. He did indeed cough up some barium that he had swallowed, two different openings in the diaphragm being negotiated by the barium *en route*. Only a left lower lobectomy with repair of the diaphragm and stomach could have saved him, but both his age and his general condition denied him that possibility.

INTRATHORACIC FIBROMA.[1]

By M. P. SUSMAN,
Sydney.

E.F., AGED fifty-two years, had been treated for asthma and bronchitis for years on account of a chronic cough, orthopnœa and discomfort in the chest. Her general condition had remained fairly good, and there were no gross signs of raised intrathoracic pressure. The chief physical signs were dulness to percussion over the upper half of the right hemithorax posteriorly and absence of breath sounds over this area. Diffuse pigmentation of the skin of the arms and chest was present and had been noted several

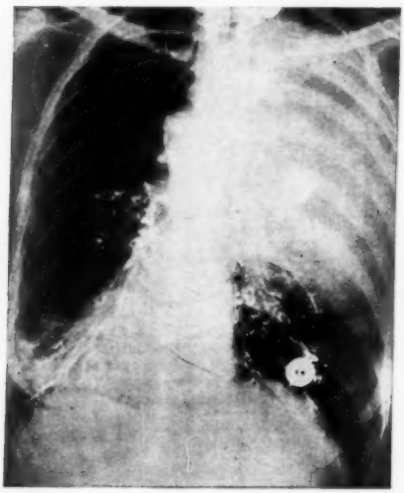

FIGURE I.

FIGURE II. (Note the forward displacement of the trachea.)

years previously. Skiagrams showed an opacity of the upper half of the right lung field, corresponding to the area of abnormal physical signs. This opacity was homogeneous and round, with a fairly distinct outline, and it was situated posteriorly. The diagnosis seemed to rest between a hydatid cyst of the lung and a solid tumour of the posterior mediastinum or chest wall.

On passing a bronchoscope, I found that the vocal cords were normal, that the trachea and right main bronchus were displaced forwards, that the lumen was narrowed from behind forwards, that the mucous membrane was healthy, and that there was no abnormal pulsation. I injected iodized oil into the tracheo-bronchial tree and none of it entered the area corresponding to the opacity (Figures I and II).

There were no reactions to the Casoni and Wassermann tests, and the results of other laboratory tests were negative.

[1] Accepted for publication on May 9, 1939.

FIGURE III. (Outer surface.)

FIGURE IV. (Cut surface.)

Operation.

Dr. H. Daly administered a mixture of cyclopropane, nitrous oxide and oxygen, and I gratefully acknowledge his skilful services and his patience; at one stage when the patient was seriously shocked, I suspended the operation for nearly an hour while a blood transfusion was given.

I made a curved incision along the vertebral border of the scapula to a point an inch below and in front of the angle, and freely mobilized the scapula. Four to five inches of the fifth, sixth and seventh ribs were removed subperiosteally from the transverse processes forwards, and then short segments of the fourth and third ribs near the angles; the intervening intercostal bundles were doubly ligated and divided near the lateral edge of the *erector spinæ* muscle. A vertical incision, parallel to this muscle, was now made from the level of the third rib where it had been divided, down to the level of the bed of the seventh rib, through the whole length of which the incision

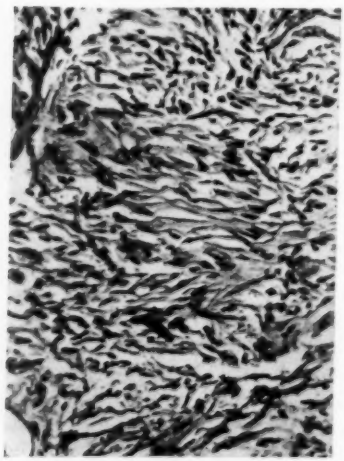

FIGURE V. Photomicrograph of a relatively cellular area. × 140.

FIGURE VI. Photomicrograph of an area in which hyaline transformation of fibrous tissue has occurred. × 140.

was prolonged forwards. The pleural cavity was thus freely opened to expose a solid tumour covered by the mediastinal pleura. A number of vascular adhesions connected the tumour to the chest wall and to the mediastinum, and these were doubly tied and divided; one band, thicker than the rest, seemed to be a pedicle passing backwards to the costo-vertebral gutter. It was at this stage that the patient's condition failed and I desisted from operating until a blood transfusion had been given. The tumour was delivered intact as soon as the "pedicle" was divided. Some troublesome bleeding from the chest wall and from the surface of the lung was controlled with sutures and ligatures and "Aristol". The whole lung lay, blue and airless, against the mediastinum and it expanded only slightly when the anæsthetist raised the intrapulmonary pressure. I closed the main wound entirely and brought out a drainage tube through a stab wound over the posterior part of the bed of the seventh rib; this tube was immediately connected to a water trap, and I had the patient remain undisturbed in the theatre. Two hours later her pulse was impalpable and the sphygmomanometer registered a systolic pressure of 60 millimetres of mercury. Another blood transfusion was given at this stage, and three hours later her condition had improved sufficiently to justify her return to the ward.

Progress.

The patient's convalescence was satisfactory, and she was up twenty days after the operation with the drainage tube still present and discharging frank pus; for the first ten days it drained sero-sanguineous fluid. The upper part of the lung expanded well, but the lower part was slow to do so, and later I had to resect a segment of the tenth rib near the angle to secure adequate drainage of the residual cavity. This was completely obliterated five months after the operation by the lower part of the lung at last expanding. Her health is good and she has lost all her symptoms (September, 1940).

Pathological Report.

Dr. A. D. Gillies has made the following report:

"*Macroscopic Appearances.*—The tumour measured 16 centimetres by 10 centimetres by 11 centimetres. Its outer surface was glistening and the tumour appeared to have been lying relatively free in the pleural cavity. There were several coarse lobules on the surface. On section, it was extremely hard and its appearance bore a very striking similarity to a fibromyoma of the uterus. It weighed 900 grammes (two pounds). (Figures III and IV.)

"*Microscopic Appearances.*—The tumour is of connective tissue origin. On the whole it is very fibrous, but there are some moderately cellular areas present. Collagen fibres are recognizable in some situations, but hyaline transformation is widespread, and an hydroptic form of degeneration has occurred in one portion examined.

"The cell boundaries cannot be distinguished, but the nuclei are fusiform and sometimes wavy in outline.

"There is not sufficient histological evidence to determine the precise tissue of origin. Tumours in the pleural cavities having general characteristics similar to this one are believed to arise from the sheaths of nerves and in some areas in the present sections there is some 'palisading' of the nuclei, which, although consistent with and possibly suggestive of a neurogenic origin, is hardly definite enough to warrant such a diagnosis on purely histological grounds.

"There are no ganglion cells to be seen and specific staining fails to reveal any muscle fibres. (Figures V and VI.)"

RENAL LITHIASIS AND HYPERPARATHYREOIDISM.[1]

By K. B. Noad and I. Douglas Miller,
Sydney.

A world-wide series of reported cases of hyperparathyreoidism has in the past ten years resulted in the accumulation of much knowledge of this subject. Knowledge of all its aspects is, however, far from complete, and therefore each new case may help a little towards a full understanding of this complex clinical and pathological problem. It is because of several features of interest that the following case is recorded.

This patient was referred to one of us (K.B.N.) on February 1, 1938, by Mr. R. H. Bridge, whom the patient had consulted for attacks of renal colic associated with the passage of numerous stones. Mr. Bridge had formed the opinion that the renal calculi were probably the result of an abnormal metabolic process.

The patient was a male, aged twenty-two years, whose symptoms had begun towards the end of 1928, at the age of thirteen years, with pain in the right side of the abdomen and in the back. The pain was not of great severity, and was most noticeable when he raised the right arm, and this had forced him to give up playing cricket. His appendix was removed in February, 1929, under ether anæsthesia, and following the operation vomiting had been very troublesome and prolonged, and he had rather a stormy convalescence. After operation the pain in his right side continued and albumin was constantly found in the urine. In December, 1929, an X-ray examination of the renal tracts revealed numerous stones in his right kidney, for which nephrotomy was performed in January, 1930. One large stone was removed, but some of the smaller stones had to be left. This operation was also performed under ether anæsthesia, and again his post-operative condition became critical from excessive vomiting.

Attacks of renal colic and the passage of small stones continued till June, 1932, when, after an attack of renal colic, he had profuse hæmaturia. X-ray examination at this time revealed numerous stones in both kidneys, the right containing most.

In the succeeding years he had many attacks of colic, and passed dozens of stones. It was quite usual for a game of tennis or a ride on horseback to be followed by an attack of colic, with hæmaturia and the passage of stones.

In February, 1935, left ureterotomy was performed under gaseous anæsthesia for the removal of a stone. His vomiting after this operation was intense, and for days he was gravely ill.

Attacks of colic and the passage of stones continued, and in January, 1938, after a very severe attack of colic, a particularly large stone was passed. This was friable, measured 1·0 by 0·05 centimetre, was yellow in colour and had a rough surface. There were no other symptoms of importance. He had had no pain of any kind in long bones or joints, and had never sustained a fracture.

The patient's mother stated that he had a marked dislike for salt. This appeared to have developed during the years of illness, as she did not remember it in his childhood. He took no salt with his food and would complain if more than the smallest quantity was used in cooking.

He had suffered from attacks of asthma in childhood, but had been free for the past eight or nine years. Otherwise his previous health had been satisfactory.

Physical examination revealed no significant abnormality. Well marked hirsuties was present on the trunk. This is mentioned because we have noted it again recently in a small female child suffering from hyperparathyreoidism. A slight kyphoscoliosis was the only abnormal feature recorded in an examination of his bones, and no thyreoid or parathyreoid tumour was palpable. The systolic blood pressure was 130 and the diastolic pressure 80 millimetres of mercury. The urine contained a cloud of albumin

[1] Accepted for publication on February 21, 1939.

and numerous red cells, leucocytes and some epithelial cells. The calcium content of the blood was 16·9 milligrammes per 100 cubic centimetres. The calculus recently passed was found to consist of magnesium and calcium phosphate. Confirmatory estimation of the blood calcium yielded a figure of 13·0 milligrammes *per centum* and the phosphorus content of the blood was 3·9 milligrammes *per centum*.

X-ray examinations of the skeleton were made by Dr. H. R. Sear, and some decalcification was apparent in many of the bones examined. In the fibula there was a small translucent area, which Dr. Sear thought might indicate a commencing cyst (see Figure I). The patient was operated on (I.D.M.) on March 7, 1938.

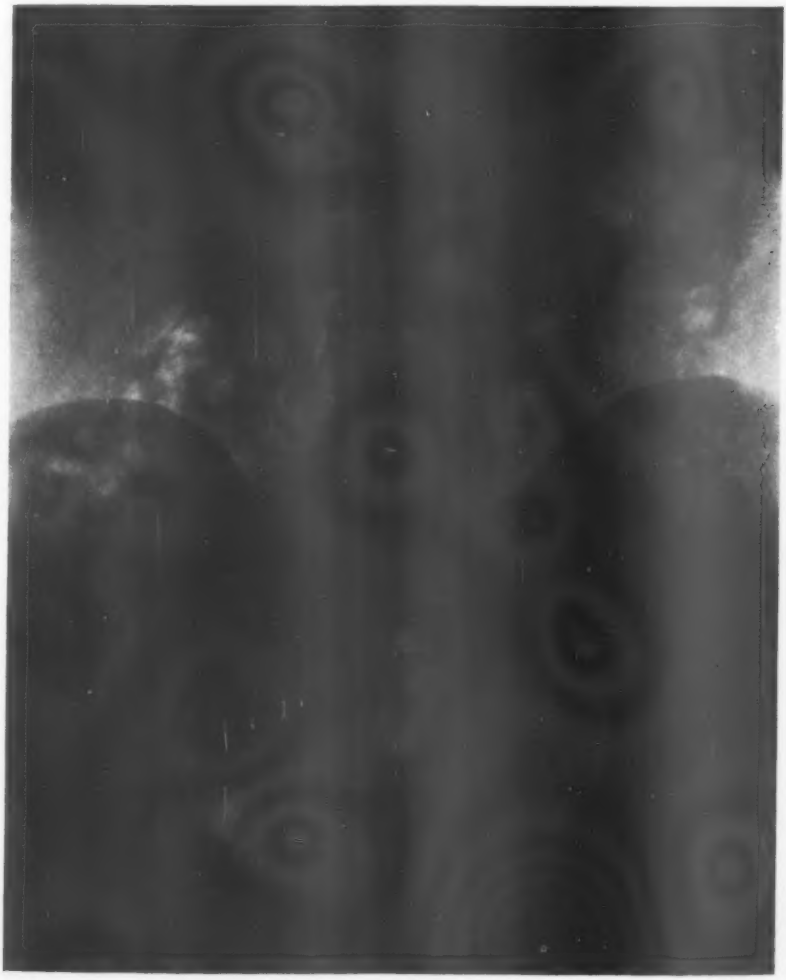

FIGURE I. Radiogram showing bilateral renal calculi.

The operation consisted in the removal of the parathyreoid adenoma. A very wide exposure of the thyreoid region was made under local anæsthesia and "Omnopon" and scopolamine narcosis.

After reflexion of the skin and platysma flap, a transverse incision was made across the anterior neck musculature, the infrahyoid group of muscles and the most anterior part of the sterno-mastoid muscle on each side being divided. On retraction this gave a thoroughly satisfactory exposure of the thyreoid gland.

Search was made first within the fascial envelope of the gland on the left side, and was continued posteriorly by gently rotating and retracting the gland medially. This manœuvre was facilitated by preliminary division of the middle thyreoid vein. A small body at the lower pole of the gland on the posterior aspect was removed.

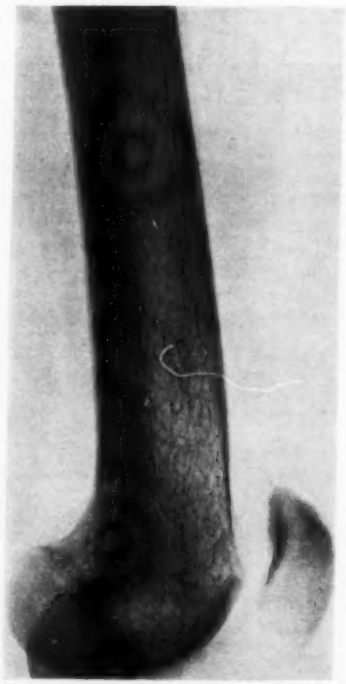

FIGURE II. Femur.

FIGURE III. Humerus.

The posterior layer of the thyreoid envelope was then split, and a search was made in the deep compartment of the neck. Nothing abnormal could be felt.

A similar procedure was followed on the right side. On opening the posterior layer of the thyreoid envelope a rounded yellow body lying posteriorly against the œsophagus was seen. It was soft and almost impalpable, but in colour very distinct

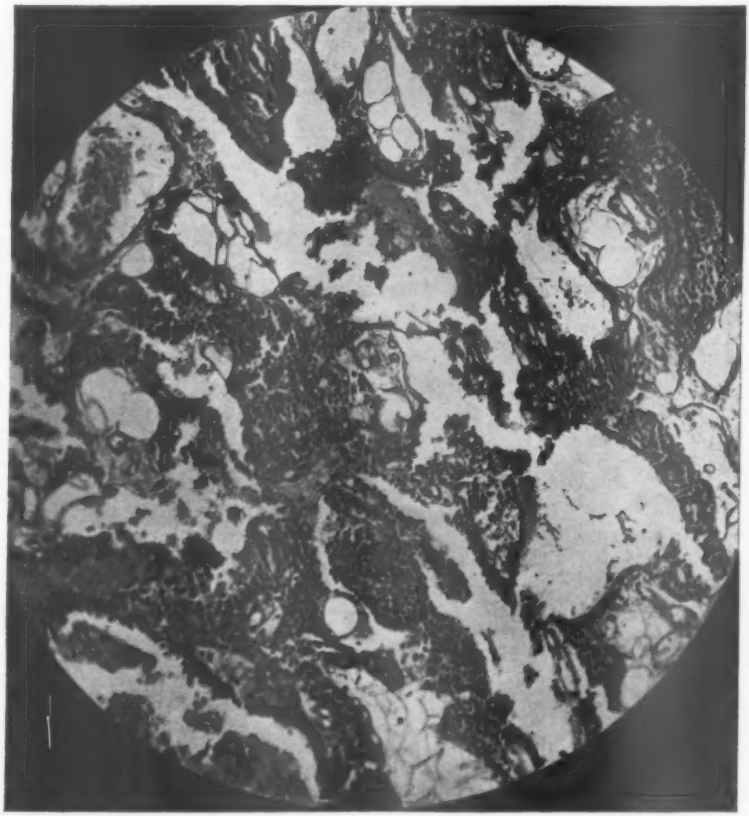

FIGURE IV. Normal parathyreoid.

from the thyreoid. It was readily mobilized and found to be attached by a fine vascular stalk to the superior thyreoid artery.

The striking features of this tumour were the impossibility of palpating it beneath the overlying fascia and its very distinct appearance. There could be no confusion between it and thyreoid tissue.

Description of Specimen.

The tumour was ovoid, measuring 2·0 by 1·0 by 0·5 centimetres. It was attached superiorly by a fine vascular stalk. In colour it was yellow. The cut section showed compact homogeneous yellowish structure.

The first small body removed was round, yellow in colour, and 0·5 centimetre in diameter. Histological examination showed the small nodule to have the characteristics of a normal parathyreoid. The characters of the large tumour were those typical of a parathyreoid adenoma.

Subsequent History.

After the operation he was returned to bed in excellent condition, and there was no post-operative vomiting.

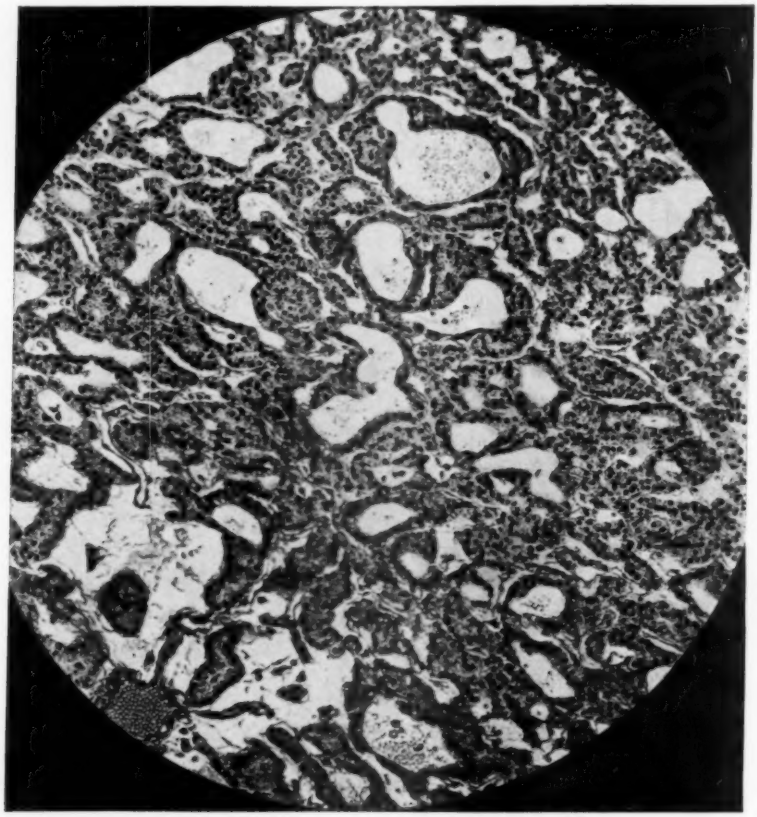

FIGURE V. Parathyreoid adenoma.

On March 19, two days after operation, Chvostek's sign appeared and the patient's blood calcium content had fallen to 11·8 milligrammes *per centum*. Clinical evidence of hypocalcæmia became more marked each day, but some moderately severe spasms of tetany were quite well controlled by the occasional administration of parathormone.

On March 30, when these symptoms were very much in evidence, his blood calcium content was 9·0 milligrammes *per centum* and blood phosphorus 5·0 milligrammes *per centum*.

He was given a high calcium diet, with calcium and vitamin *D* by mouth, and he left hospital looking remarkably well, but with an active Chvostek's sign, on April 2, 1938. His blood calcium content was then 9·1 milligrammes *per centum*.

After returning home he had muscular spasms of the extremities with increasing frequency and violence, particularly in the bath each morning, and he could not be left unattended. Psychical symptoms also began to appear, "fogginess" in the head, failure of concentration, weariness and lack of interest. At first he found it very hard to think clearly, but this was later supplanted by abnormal mental activity, and the sight of common objects provoked a host of queries in his mind as to their origin, constitution, weight *et cetera*. For example, the sight of a train would immediately

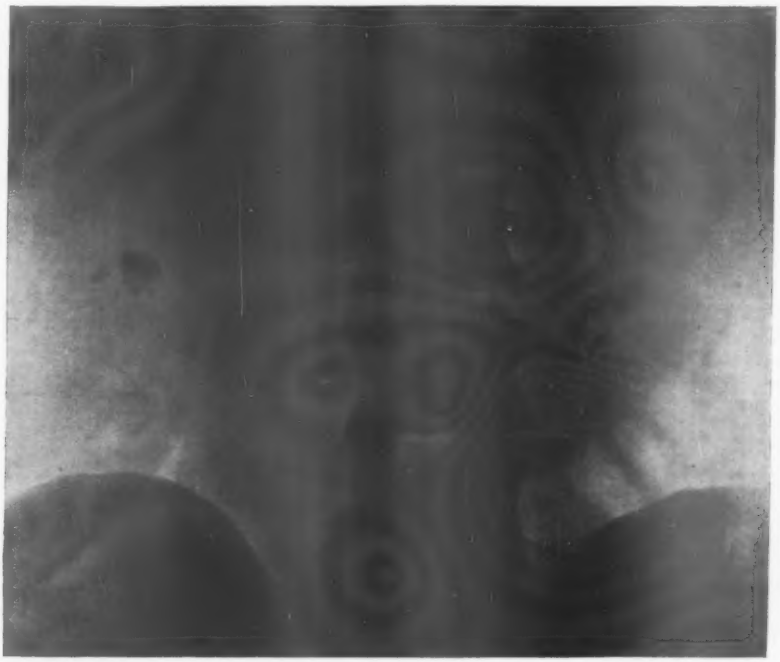

FIGURE VI. Renal areas six months after operation.

make him wonder where it had come from, what time it had started, what time it would arrive at its destination, and every other possible query.

Symptoms of hypocalcæmia were now so marked that ten grains of ammonium chloride were given in capsule form twice a day and appeared to bring about some improvement, but later he had a recurrence with symptoms of laryngeal spasm, and again, after the passage of a small stone, spasm of the vesical sphincter.

By the beginning of September, 1938, his condition appeared to have greatly improved, though he continued to be easily and unduly fatigued on exertion. Chvostek's sign was still easily elicited, though not nearly as active as formerly. His knee jerks, which three months before had been hyperactive, were now depressed and present only on reinforcement. Ankle jerks were normal. It was somewhat surprising, therefore, to find that his blood calcium content was now 6·2 milligrammes *per centum*. This was subsequently confirmed several times. Again, on October 21, his calcium level was

6·8 milligrammes, and his phosphorus level was also 6·8 milligrammes *per centum* although Chvostek's sign was only feebly present and compression was required to produce muscular spasm.

During recent months numerous small calculi have passed and X-ray examinations have demonstrated a fragmentation and lessening density of the calculi in the right kidney, and their complete disappearance from the left kidney.

It is interesting to note in these recent skiagrams that the vertebræ are showing a very marked increase in calcification density.

The urine still contains albumin, but no red cells or crystals. Renal function tests in September revealed a blood urea nitrogen content of 20 milligrammes *per centum*, with a satisfactory result to the urea concentration test.

Comment.

The earlier cases of hyperparathyreoidism were associated primarily with skeletal changes, and only later was renal lithiasis recognized as an equally important primary effect of the disorder. Castleman and Mallory in a report in 1935 note that previously only three instances of hyperparathyreoidism, associated primarily with renal lithiasis, had been recorded.

It is now recognized that hyperparathyreoidism may effect calcium deposition in the kidneys in various ways: as gross pelvic lithiasis, or as tubule deposit leading to nephrosclerosis, and possibly often in an acute form leading to rapid renal failure.

Many instances of pelvic lithiasis have been recorded, and some observers have stated the belief that this is always a unilateral condition. The case above recorded was an instance of bilateral lithiasis, with insignificant and secondary bone changes. Albright has stated the view that bone changes in such a case may be an index of the duration of the disease. In this case the disease was known to have been active for at least ten years. We have had the experience of watching the calculi rapidly disappear following parathyreoidectomy.

Acknowledgement.

We wish to thank Dr. Eva Shipton for her help in the pathological investigation of the case.

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Addendum.

When seen early this year the patient was free of all symptoms and X-ray examination showed the complete disappearance of all calculous deposits from the kidneys.

The Australian and New Zealand Journal of Surgery.

All articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

Authors are requested to submit two typescript copies of all articles.

References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given, with full date in each instance.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in indian ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

VOL. X. OCTOBER, 1940. No. 2.

THE POSSIBILITY OF CHEMOTHERAPY IN WAR SURGERY.

FOLLOWING an increasing experience of the efficacy of chemotherapy by means of sulphanilamide and allied compounds in the acute streptococcal infections, and in view of the great mortality from infected wounds in war, the question of the value of these agents in combating specific infections has now become of even greater importance.

The two great groups of infections met with in war wounds are those due to the streptococcus and those due to the gas gangrene group of organisms. It has been recognized as a result of experience in the last war that the clinical stories of these two types of infection are quite distinct. Infection with the gas gangrene group takes place at the time the wound is inflicted, and has a rapid course during the first forty-eight hours; but streptococcal infections, which caused about 70% of the deaths from infected wounds, are often transmitted from human sources, often no doubt during ward dressings, and as a rule the infection appears some days after the actual infliction of the wound.

The two questions which arise are how far one can apply prophylactic measures against either infection and what can be done for the patient when

they are established. Animal experimentation by a number of competent and careful observers, combined with some clinical observations on both streptococcal and gas gangrene infections, particularly with the common *Bacillus welchii*, has shown conclusively that chemotherapy with these new drugs can be very useful prophylactically. It has been proved that animals can be protected against both gas gangrene and streptococcal infections, the necessary protection being dependent on the maintenance of an adequate concentration of circulating drug. Sulphopyridine ("M & B 693") was found to give protection against both types of infection, but sulphanilamide only against the streptococcus. As it is essential for successful prophylaxis that a relatively high level of blood concentration of the drugs should be maintained, the problem differs in two types. Under field conditions it will be very difficult, if not actually impossible, to maintain such a high concentration during the first twenty-four hours. A suggestion made that every soldier with deep wounds should receive an adequate dose of the drug in lemon juice every two hours during his passage from the front line, is, of course, to anyone who knows the practical problems of evacuation, quite fantastic. It is essential that prophylactic dosage against gas gangrene should be given at the earliest possible moment, that is, at the time of the first dressing at the field ambulance; a large initial dose of eight grammes of sulphopyridine should be given then—along with the antitetanic serum—and this should carry the patient over for about twenty-four hours, by which time it should be possible in the majority of cases to ensure that he will receive regular one-gramme doses every four hours.

An attempt should be made to slow up the rate of absorption of this large initial dose of the drug by giving at least half of it in the form of solid tablets. Such a method would probably be very valuable in checking the development of gas gangrene and, if combined with the still very essential excision of the wound, removal of foreign bodies and adequate drainage, should do much to reduce the incidence and mortality of these very fatal infections. The same drug, if continued during the course of evacuation, would be also an effective prophylactic against the commoner and more delayed streptococcal infection.

With regard to the treatment of the established infections, there seems no doubt that in the case of gas gangrene the greatest reliance must still be placed on adequate surgical excision and drainage, with massive doses of specific antisera; at the same time, it is possible that sulphopyridine may prove so valuable that it will replace the latter.

In the established streptococcal infections there is no doubt that either sulphanilamide or sulphapyridine will be very efficacious—if it is given in doses of one gramme every four hours and if administration is stopped on the fifth day. It will be necessary in these cases to take all the well-known

precautions as regards dosage and idiosyncrasy, and to watch for unfavourable reactions or complications.

One feels that during the present conflict full knowledge of the efficacy of these drugs will be arrived at, but that it is incumbent on all war surgeons not only to do what they can to keep accurate clinical records of as many cases as possible, but also to correlate the results carefully with accurate bacteriological investigations and to experiment with various combinations and dosage of these relatively new therapeutic agents.

H. R. DEW.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

PANCREATIC FISTULA AFTER GASTRIC RESECTION.

Krabbel (Aix-la-Chapelle): *Zentralblatt für Chirurgie*, Volume lxv, February 26, 1938, pages 461 to 463.

In 1929 a patient underwent a posterior gastro-enterostomy for duodenal ulcer. After a period of apparently complete recovery, the original pains reappeared and, in 1933, the presence of peptic ulcer perforated into the colon was established.

At the second operation it was found the duodenal ulcer had healed and was replaced by a fine whitish cicatrix; the anastomosis was disconnected, and the stomach and jejunum were restored to normal conditions; and partial resection of the colon with end-to-end suture was carried out. The patient recovered.

In 1935 the pains reappeared, and radiological examination showed a recurrence of the duodenal ulcer.

A third operation comprised gastro-duodenal resection after Pólya-Reichel, with antecolic gastro-jejunostomy and entero-anastomosis. The ulcer had penetrated the pancreas and had to be detached by thermocautery. It was then ascertained that the common and pancreatic ducts were gaping into the base of the duodenal wound. The termination of the common duct was closed by a ligature and a lateral anastomosis was made between the common duct and the duodenal stump. The orifice of the duct of Wirsung was so constricted that a sound could not be introduced into it; so the pancreas was excluded from the peritoneal cavity by securing it to the plane of the abdominal wall. The next day a pancreatic fistula became established. This fistula persisted for sixteen months, occasionally drying up for a few days. The fever and pains would appear and disappear when drainage was again established.

At a fourth operation to close the fistula a coloured injection was made into the pancreatic duct. This was then dissected to the pancreas, a distance of one centimetre. The peritoneum was opened at the inferior angle of the wound, and a loop of jejunum, 15 centimetres in length, withdrawn; an anastomosis was established between the limbs of the loop at its base, and the canal of the fistula was implanted into the summit of the loop and the wound in the abdominal wall was closed. There was for eighteen days a slight flow of pancreatic juice, which ended by spontaneously drying up. The patient increased greatly in weight and recovered completely.

CH. LENORMANT.

Analysis from *Journal de chirurgie*, Volume lii, July, 1938.

REMOTE RESULTS IN THE PLASTIC SURGERY OF THE BILE DUCTS.

A. J. Bengolea and C. V. Suarez: *Revista medico-quirurgica de patologia feminina*, Volume v, April, 1938, pages 332 to 362.

The authors discuss the different procedures of plastic surgery of the bile ducts, and refer to the frequency of ascending infection in anastomoses between the digestive and biliary systems.

They cite experiences. A woman, aged thirty-two years, was operated on for chronic calculous cystitis. The gall-bladder contained numerous calculi. A cholecystectomy was performed. In the course of the operation cholangiography revealed the existence of a stenotic inflammation of the sphincter of Oddi. An anastomosis between the common duct and the duodenum was made. The patient's condition was much improved for two years, when dyspeptic troubles and the pains in the right hypochondrium reappeared. The Meltzer-Lyon test revealed the presence of pus in the continuum of the bile ducts. A diagnosis of chronic ascending infection of the common

duct was made, and the patient was reoperated on. The anastomosis between the common duct and the duodenum, reached after an intricate dissection, was opened. The common duct was explored with a sound. A Kehr tube was inserted into the common duct, when the ampulla of Vater was found to be permeable. The anastomosis was disconnected, and the duodenal opening was closed by a double row of sutures. Twenty-four days after the operation the tube in the common duct was removed. Subsequent examination with a duodenal tube showed that the sphincter of Oddi was functioning normally.

A second observation: In March, 1930, a patient, aged forty-nine years, with a syndrome of icterus, pruritus, febrile attacks, and bile which contained pus (shown by a duodenal tube) was operated on for an obstruction of the common duct. The common duct was exposed and a calculus was removed by incision of the duodenum. In order to mobilize the calculus it was necessary to do a duodenotomy, to carry out retrograde catheterization, and to incise the ampulla of Vater. The common duct was closed by a double row of suture ("0" catgut) and the subhepatic space was drained. The patient, however, from time to time suffered from attacks of epigastric pain with febrile attacks.

Early in December, 1935, he had another attack of violent pain accompanied by a slight icterus. A duodenal tube revealed the presence of pus in the bile. With the aid of an Einhorn tube, barium was injected into the duodenum; and an ascending cholangiograph showed that the bile ducts were quite patent. The patient then became affected with a serious form of suppurative parotiditis and, despite the treatment instituted, died. *Post mortem*, the bile ducts contained an abundant muco-purulent exudate. An opening three to four millimetres in diameter was found between the common duct and the duodenum just above the ampulla of Vater. Numerous disseminated abscesses were present in the liver.

G. MENEGAUX.

Analysis from *Journal de chirurgie*, Volume lii, July, 1938.

CONTRIBUTION TO THE STUDY OF POST-TRAUMATIC PANCREATITIS.

H. Kastrup (Hamburg): *Der Chirurg*, Volume x, January 15, 1938, pages 57 to 58.

A BOY, aged twelve years, falling from a bicycle, received from the handle-bar an injury in the epigastric region. On the evening of the accident he vomited and complained of dull pains. The next day the vomiting became more frequent and the pains more violent. On examination, the injured area was painful, but there was no rigidity. Three days later violent epigastric pains set in and radiated into the loin and left costo-vertebral angle. Symptoms and signs became more definite: *défense musculaire* in the epigastric region was noted; general symptoms were aggravated; and the urinary amylase was estimated to reach 256 Wolgemuth units.

A diagnosis of circumscribed peritonitis was made and an operation was carried out. On opening the peritoneum a large quantity of blackish-brown fluid escaped. Numerous patches of cytosteatonecrosis were seen in the omentum. Inspection of the pancreas through the gastro-colic ligament revealed that half of this gland was necrosed and of a dirty brown colour, the tissue of the necrosed part being friable and, in places, transformed into pulp. Tamponade and drainage were instituted. The patient recovered.

J. CH. BLOCH.

Analysis from *Journal de chirurgie*, Volume lii, July, 1938.

THE TECHNIQUE OF REDUCTION OF SPINAL FRACTURES: DIRECT SUPPORT FROM SUBOCCIPITAL AXIS.

Pierre Mallet-Guy: *La presse médicale*, Volume xlvi, January 22, 1938, pages 131 to 133.

THE author thinks that the technique of Böhler for the reduction of fractures of the spine has two defects. In the first place, it is uncomfortable: the position is painful for a patient who is injured and who becomes rapidly fatigued by the painful tension on the arms, which involuntarily contract in order to avoid slipping from the table; and the pressure on the chin, which causes a forced flexion of the head, with at times a stifling sensation and a choking feeling, is disturbing. In the second place, the resistance of the muscles of the scapular girdle hinders and retards the setting of the fractures in lordosis; it is the overcoming of their contracture that facilitates the process of reduction of the broken vertebra. Suspension in the dorsal decubitus involves neither of these inconveniences; but the position is not more comfortable. Reduction

occurs as much from the continued traction exerted by the weight of the body. There is the risk of ulceration at the point of application of the band. Moreover, the preparation of the essential part of the plaster apparatus, the posterior loop, is troublesome.

The author, keeping throughout to the principle of ventral decubitus, has therefore sought to improve the superior point of support of the spine, by transferring it to the occipito-atlantal interspace. This improvement is effected by employing a removable helmet and support, a description of which, with numerous figures, will be found in the article by M. Mallet-Guy.

ANTOINE BASSET.

Analysis from *Journal de chirurgie*, Volume lii, July, 1938.

ANEURYSM: OPERATIVE TREATMENT.

M. Kroeff: *O. Hospital*, Volume xii, July, 1937, pages 91 to 111.

THIS paper concerns two analogous cases. The first is that of a man, forty-three years of age, who had been treated for six months for rheumatism, and who was found to have a tumour the size of a hen's egg at the level of the interclavicular notch, near the right sterno-clavicular joint. The tumour rapidly increased in size, and soon encroached on the right half of the thorax and the right supraclavicular hollow. On inspection, the tumour expanded rhythmically. On palpation, free pulsations synchronizing with the heart beats were noted. The inner half of the clavicle seemed to be destroyed. No pulsation existed along the course of the right carotid or the right axillary artery; there was no sign of mediastinal compression. The tumour was obviously an aneurysm. An attempt was made to identify the vessels involved in the aneurysm. An X-ray examination carried out after the injection of an opaque substance into the trunk of the right axillary artery showed that this artery, like the subclavian, was compressed or destroyed by the aneurysm. An effort was then made to form a coagulated mass in the aneurysm by injecting into it 50 gr. of a mixture of "Perabrodyl" and iodide of sodium in equal parts. Two days later no difference in the size of the tumour was evident, but its consistency had changed; symptoms of acute iodism, however, were noted and the urine showed traces of albumin. Another injection was made with the intention of obtaining an X-ray photograph of the aneurysm. This showed a rounded shadow astride the clavicle; the course of the carotid or of the subclavian artery was not outlined. The tumour was then definitely thought to be an aneurysm of the brachio-cephalic trunk. In the next few days the aneurysm ruptured spontaneously. The hæmorrhage was successfully arrested by compression dressing. On January 4, 1937, a transverse incision was made at the level of the second rib. The second and third ribs were extensively resected (10 centimetres). The pleura of the mediastinum, which is delicate, was separated. During this manœuvre there was a hæmorrhage, which could not be stopped by plugging, and the patient died. The autopsy revealed the existence of an ectasia of the ascending arch of the aorta. The dilatation was the size of a large orange. The author concludes from his observation that the localization of aneurysms at the base of the neck is not always easy to diagnose.

The second case is that of a man, forty-one years of age, who had an aneurysm of the arch of the aorta. The right humeral artery was punctured and an arteriograph was made. The puncture allowed the injection of the axillary artery and the subclavian up to their origin at the aortic arch. At the moment when the injection was ended, the patient complained of a very intense pain at arm level, which disappeared in two or three minutes. The patient has not been treated.

G. MENEGAUX.

Analysis from *Journal de chirurgie*, Volume lii, August, 1938.

Reviews.

The Australian Army Medical Services in the War of 1914-1918. By COLONEL A. G. BUTLER, D.S.O., V.D., B.A., M.B., Ch.B.; Volume II; 1940. Canberra: Australian War Memorial. Demy 8vo, pp. 1026, with illustrations. Price: 21s. net.

STUDENTS of history and more especially members of the Australian Army Medical Corps, past and present, will welcome the publication of the second volume of the official history of the Australian Army Medical Services in the war of 1914-1918.

The first volume dealt with the campaign in Gallipoli, Palestine, Sinai and the occupation of German New Guinea. The present volume deals with the experiences of the Australian Army Medical Corps in the western theatre of the war. A third volume is to follow dealing with certain clinical issues, technical aspects of surgery, gas warfare, influenza and venereal disease, and the dental, massage and nursing services, the Royal Australian Navy and the Royal Flying Corps.

The appearance of Volume II is particularly timely at this juncture. The younger surgeons who had not the fortune to gain first-hand experience in the war of 1914-1918 should study this book carefully. For those who are likely to be called on for service in the present war, a serious contemplation of the problems as here presented is essential. For the older men who look back on their own experiences in the war, the history is of profound interest. No medical officer now serving can afford to neglect this excellent record.

The work is divided into three sections; the first deals with the period of attrition warfare. Fromelles, the Somme, Bullecourt, Messines, third Ypres are names which are indelibly imprinted in the memory of Australians who served in France in 1916-1917. The peculiar problems of trench warfare and the multifarious duties of the medical services are described and discussed in the lucid style of a writer who knows his subject and who also is a master of the English language. The second part is devoted to the evolution of the new methods employed in the mobile warfare of 1918. A general review of these new methods is given in preparation for the third section, which describes the operation of the remodelled medical services during the period of the war of movement, March to November, 1918. To speak of the work as a compilation would be incorrect. It is an historical record of which the author and incidentally the medical profession in Australia have reason to be proud. A survey of all the activities of the personnel of the Australian Army Medical Corps in the western theatre of the war would obviously be impossible in one volume, but a surprising amount of detail relating to units and individuals is provided by printing these personal references, extracts from diaries *et cetera*, in small type apart from the main narrative. The spacing difficulties confronting the author are obvious, but the footnotes are equally as interesting as the matter in bolder type, and in many cases are worthy of a more important place in the book.

Students of army medical administration will find much of interest in the detailed account of the complex machinery which was necessary for the proper performance of the task of the medical services. The presiding genius in this vast system was the late Major-General Sir Neville Howse, V.C., whose photograph provides a fitting frontispiece to the history. "In considering General Howse's administration it is not difficult, in the first place, for an informed observer to detect in all the activities of the department a key-note, to be discerned as clearly in the daily routine of each sub-department or office as in the minutes and correspondence of the Director. This motif we may identify as purposefulness." ". . . his supreme achievement was the creation of his Medical Administrative Headquarters, as a means for getting things done."

Fifty-six pages are devoted to the "Medical Direction of the A.I.F." In this chapter the work of Howse is appraised. The author's own opinions of the Director are quoted: "It may be doubted whether since Baron Larrey directed medical affairs for Napoleon and Sir James McGrigor for Wellington, any head of a medical service has gained so completely the confidence of the military command, or exercised so great a personal influence in military affairs as did Surgeon-General Howse within the scope of the A.I.F." Such was the man of whom it was said by Surgeon-General Williams in 1914 that "he was devoid of any higher military knowledge when he assumed that position. It is doubtful whether he knew of the existence of such a profound work as Field Service Regulations Part II."

An interesting account of the "war" between Howse and the Australian home authorities on the vexed question of the physical standards of recruits is of especial interest to those engaged in the important work of medical boarding. The chapter on evacuation within the army zone is systematically written and provides an excellent textbook for those likely to be engaged in the important work of rescue which is the essential service rendered by field medical officers close to the front line. Whatever changes have developed in modern practice, the basic principles as illustrated in the actual methods employed during the engagements here recorded, cannot fail to be of great educational value to medical officers in the field. A chapter on the general surgery of wounds in war tells of the trial and error methods which eventually led to the practice of excision and primary suture. The ineffectiveness of the antiseptics

which were employed in the earlier stages is emphasized, and the evolution of wound surgery may be regarded as a triumph for the aseptic method. Australian surgeons appreciate the tribute to the work of E. T. C. Milligan, who published an article in *The British Medical Journal* in June, 1915, on the "Early Treatment of Projectile Wounds by Excision". Opposition and even hostility to this procedure were so acute at first that Milligan was ordered to discontinue surgery, but the results of the methods were so striking that even the most conservative consultants soon approved of its general adoption. Thus the exigencies of the war enabled men to overcome prejudices in a short time and adapt their minds to new surgical procedures. A similar change of established practice in peace time would have required many years.

The problem of the casualty clearing station is discussed. The eternal conflict in the mind of the medical staff officer, trained as he is to regard every human life as precious and yet having to fit in his work of evacuation of casualties as part of a general military plan, is nowhere more acute than in the matter of deciding just how close to the front he can take his operating teams. One fact emerged from the treatment of surgical wounds, and that was that, apart from the first aid in the line, the first actual handling of the wound should be a full-dress operation. Sad though the reflection may be, human and surgical considerations must be sacrificed to military necessity. The success of the operating teams who worked under emergency conditions in forward areas, however, demonstrated that it is possible to reconcile the divergent interests. The effect on the morale of the troops and the lessened morbidity and mortality as a result of this shifting forwards of the hospital for immediate treatment must have been incalculable. A fitting tribute is paid to the medical officers and stretcher bearers who carried out their noble work of rescue during so many terrible engagements. The exhausting carry over the morass of the devastated Somme battlefield under continuous shell fire, the heavy casualties among the bearers themselves, would have strained the bravest hearts. Yet that work was done without complaint, and many of the Australian Army Medical Corps non-medical personnel, after a year or two of this work, found the only promotion possible by joining combatant units.

The prevention of disease in war as a function of the medical services provides 120 pages of fascinating reading. In this sphere the medical officer fills a most important role. It has been truly affirmed that the two most important officers in a regiment are the commanding officer and the medical officer.

Finally, the author's choice of phrase is nowhere more appropriate than in the following reflection upon the "military factory for repair and reconditioning": "The tragedy of repeated woundings in battle, followed by the weary round of convalescence and retraining back to the tension of ever present death, was perhaps, in some part, the sacrificial substitute for the services of those who were unable or too precious to be enlisted; to that extent it was part of the price paid by Australia for escape from conscription. This freedom perhaps was worth the price; but a plant of rosemary for remembrance should not be lacking from the pleasant garden that we have in testament from those who did the paying; and not the less because the toil of the treadmill has left its deforming work on some of those who remain."

Colonel Butler, soldier, doctor and historian, has had the noble task of rescuing from oblivion those who deserve to be eternally remembered. In the words of Emerson, "the use of history is to give value to the present hour and its duty".

The British Encyclopædia of Medical Practice, Including Medicine, Surgery, Obstetrics, Gynæcology and Other Special Subjects. Surveys and Abstracts, 1939. Under the general editorship of SIR HUMPHRY ROLLESTON, Bt., G.C.V.O., K.C.B., M.D., D.Sc., D.C.L., Lt.D.; Publishing Editor, A. CLARK, L.M.S.S.A.; Sub-Editor, G. FAULKNER, D.Sc.; 1940. London: Butterworth and Company (Publishers) Limited. Super royal 8vo, pp. 678, with illustrations. Price: 32s. 6d. net.

A VOLUME of surveys and abstracts (605 pages and an index) has been published under the general editorship of Sir Humphry Rolleston. It will be an annual publication and is planned to bring to the notice of the reader the most recent advances in the several branches of medicine.

The volume is divided into three sections: Part I, "Critical Surveys"; Part II, "Modern Drugs"; Part III, "Abstracts of Medical Literature". The critical surveys comprise reviews of important branches of medicine; the section on modern drugs deals with the advances in pharmaceutical knowledge; and the section of abstracts from medical literature is made up of epitomes from current literature—British, American and foreign.

In the first section Professor Grey Turner, of the British Postgraduate Medical School, writes the review on general surgery, and Professor James Young, of the same school, that on obstetrics and gynæcology. Sir Arthur Hurst contributes an interesting survey of the diseases of the alimentary tract, and lays down principles of treatment for gastric and duodenal ulcer and hæmatemesis; that part of his contribution which deals with "The Abuse of Purgatives" is specially practical. Lionel Colledge, surgeon to the Golden Square Throat, Nose and Ear Hospital, writes the review on "Otorhinolaryngology".

There are many other valuable reviews. Mention is made of the work of Lewis and Kellgren on the diagnostic significance of pain, and the importance of their experimental findings in regard to abdominal diagnosis is emphasized. Reference is made to recent clinical work which shows the value of progesterone therapy. Other subjects include the legal position of the practitioner in regard to artificial and intentional abortion (the case of Rex *versus* Bourne), the use of cyclopropane as an inhalation anæsthetic, the advantages and disadvantages of the various basal narcotics which are used in conjunction with nitrous oxide gas and ether. There is a rather full account of recent investigations in relation to various vitamins, and the part they play in the production of disease. There are, too, useful descriptions of new methods for the determination of corpuscular volume and quantitative method estimation of the fragility of the red cells. The treatment of obstructive jaundice also receives special attention.

The most important critical survey under the heading of drugs is that of the pharmacology of sulphonamide drugs, the introduction and development of which constitute perhaps the most remarkable advance in recent therapeutics.

Abstracts of medical literature constitute the main part of the book. These are well selected and ensure a medical encyclopædia which is always abreast of modern medical thought. Especially useful information is contained in the abstracts of recent work on anæsthesia, on rheumatoid arthritis, on blood transfusion, and on clinical observations in cholecystitis and cholangitis. These, of course, are only a few of the subjects dealt with, but they will serve to show the theme of this part of the work.

There can be little doubt that this volume will serve a most useful purpose, for it will satisfactorily solve the problem of comprehensive and therefore expensive books which lose their value because, in this age of rapid progress, they so quickly become out of date. We recommend it with the greatest confidence.

Infections of the Hand. By L. R. FIFIELD, F.R.C.S.; Second Edition, by P. CLARKSON, F.R.C.S.; 1939. London: H. K. Lewis and Company Limited. Crown 8vo, pp. 180, with 57 illustrations, including 8 plates. Price: 9s. net.

THIS book covers, in a comprehensive manner and in a reasonably small space, the surgery of the hand. The work includes a description of the anatomy of the hand; a chapter on the prophylaxis of infection; a complete discussion of the pathology of infections of the fingers and hand, including osteomyelitis and arthritis; and the treatment of infections; it concludes with a chapter on prognosis and the aspects of the condition in relation to the *Workers' Compensation Act*.

The anatomy section (33 pages—one-fifth of the whole book) is excellent. It is obviously written by a skilled anatomist and it gives a complete, clear and detailed (but not too detailed) description. This section alone would justify the publication of the book, and any surgeon, senior or junior, would be repaid for the time and trouble spent in its study. The anatomical presentation renders simple the pathology and treatment outlined in later pages.

The principles of treatment laid down for potentially infected wounds of the hand are sound; but perhaps sufficient stress is not laid on the importance of leaving wounds open and of complete rest in splints in the "position of function", though these measures are stated.

Infections of the fingers and hand are well discussed, particularly the pathology; but if any criticism is to be made, it is that the clinical signs and differential diagnosis of the various infections are not stated with sufficient detail and definiteness to make the book of supreme value to the student and house surgeon. Further, the author indulges in a great deal of repetition, but in this he is in the excellent company of Kanavel, on whose work this book is largely based. The treatment which is clearly stated is sound, but, again, for the inexperienced surgeon may not be in sufficient

detail in every instance. The methods are orthodox, every complication is dealt with, and the teaching is complete and may be safely followed.

The prognosis is perhaps too optimistic, but the periods of disability given apply only to cases in which treatment has been well carried out—unfortunately, not a very large percentage.

This is on the whole an excellent book and is worthy of study by surgeons, both young and old.

Fractures and Other Bone and Joint Injuries. By R. WATSON-JONES, B.Sc., M.Ch.Orth., F.R.C.S.; 1940. Edinburgh: E. and S. Livingstone. Super royal 8vo, pp. 735, with 1,040 photographs, X rays and diagrams. Price: 50s. net.

DEDICATED to those pioneers of orthopædic surgery, Hugh Owen Thomas, Robert Jones and C. Thurston Holland—men who made the Liverpool school of orthopædics famous—this volume is the equal of anything that has yet emanated from Liverpool. It is one of the best works on fractures that have appeared in the English language, and should be read by all practitioners who treat fractures. The appendix should be submitted to boards of management of general hospitals.

The arrangement of the book is good. A section on general principles comes first, and this is followed by sections on individual fractures in anatomical sequence. The illustrations, together with their legends, represent almost a textbook in themselves, so that much practical knowledge can be gained by simply turning the pages. They have been carefully selected and clearly reproduced.

In Part I fundamental principles are clearly and concisely enunciated, so that there can be no possible doubt as to their meaning, nor is any opportunity lost of explaining their application both in the text and by illustration. Proper emphasis is laid on the importance of radiographic control of manipulative reduction of fractures. Particularly stressed is the importance of repeating the X-ray examination immediately after the manipulation, before the patient has recovered from the anæsthetic. If the position is not satisfactory, the routine of "manipulation, fixation, and X-ray" is repeated and repeated again until satisfactory position is obtained. Accurate anatomical reposition of the fragments is insisted upon, except that a little licence is permitted in the case of long bones, provided end-to-end contact is established. In no circumstances whatever is angulation permitted, even in children..

In short, the three fundamental principles of fracture treatment are stated thus: Displacement must be corrected and redisplacement prevented under radiographic control. The fragments must be immobilized continuously and without interruption until union is firm. Joints which need not be immobilized completely must be actively exercised, but never passively stretched.

Part I also deals with such complications of fracture treatment as joint stiffness, *myositis ossificans* and ischæmic paralysis, and states quite baldly that, almost without exception, they should never be allowed to occur. Delayed and non-union are faithfully dealt with. In this first part the author also deals with the principles and practice of immobilization. He gives excellent advice on plaster technique, and deals with clinical and radiographic diagnosis, here stressing the importance in certain instances of taking skiagrams in three planes. Nerve injuries complicating fractures and modern methods of dealing with open and infected fractures are also discussed. As might be expected, the section dealing with aseptic necrosis is authoritative, and the proper procedures to be adopted after this complication has supervened are clearly and simply stated. The author is an acknowledged master of the technique of bone grafting, so that most surgeons will find the sections dealing with this aspect of fracture treatment of absorbing interest.

Throughout the remaining parts of the book the author deals with individual fractures in turn. The methods described are those used at the fracture unit of the Liverpool Royal Infirmary, where, during the past twelve years, no less than 47,300 fractures and allied injuries have been treated. These methods are invariably simple, in no way depart from fundamental principles, and are on the whole remarkably orthodox. It is interesting to note that the cumbersome wire contraptions so often advocated by Böhler in the treatment of some upper arm fractures are not even mentioned. The reader is warned that, while the vast majority of patients with fractures of both the dorsal and lumbar spinal vertebræ are better both transported and treated in hyperextension, a certain small percentage of such patients have articular processes interlocked in such a way that hyperextension before the interlocking is dealt with must increase the deformity and in consequence the risk of cord injury.

Certain "allied injuries", such as mallet finger, supraspinatus tendon lesions, and even the much neglected sprained ankle, are carefully considered. The section on that bugbear of orthopædic and industrial surgeons, "back strain", is particularly good. The question of sciatic scoliosis and its relation to herniation of the *nucleus pulposus* and hypertrophy of the *ligamentum subflavum* is discussed, and the indications for various lines of treatment are clearly set out. On the whole, the author is inclined to be conservative on the question of laminectomy—more conservative at any rate than workers in some other orthopædic centres.

The appendix should be carefully read and all its implications studied by all who are in any way concerned with the treatment of fractures, particularly those occurring in industry, and those which come within the scope of the *Workers' Compensation Act*. In it are set out in unanswerable fashion the arguments in favour of the formation of fracture clinics at general hospitals. The arguments are of great moment, not only to the medical profession, but also to certain sections of the lay public, and not least to the boards of management of general hospitals and the patients themselves. No impartial reader could fail to be convinced that the establishment of such a service could do anything but improve the standard of treatment in any hospital where no such service exists.

A full bibliography of references accompanies each section, and an index of authors is included at the back of the book. Mr. Watson-Jones should be congratulated on his important contribution to orthopædic and traumatic surgery.

A Guide to Ophthalmic Operations. By J. BRUCE HAMILTON, M.B., Ch.M., D.O., D.O.M.S., F.R.A.C.S., with a foreword by SIR JAMES BARRETT, K.B.E., C.B., C.M.G., M.D., M.S., F.R.C.S., F.R.A.C.S., LL.D.; 1940. London: H. K. Lewis and Company Limited. Demy 8vo, pp. 216. Price: 10s. 6d. net.

J. BRUCE HAMILTON, of Hobart, has written a concise and useful handbook on the choice of instruments for ophthalmic operations, their preparation, and the pre- and post-operative management of the patient. The title of the book is misleading; actually surgical technique is not detailed, but in no other respect is the book open to adverse criticism.

All routine eye operations are grouped alphabetically, and for each there are listed the medicaments, equipment and instruments required; and a note is made of the individual treatment that the patient should receive. The requirements for the treatment of each patient are presented under three headings: those for the day before, those for the day of operation, and those for the days following it. Throughout there is presented a wealth of studied detail that indicates, on the author's part, years of careful attention to the minutiæ of ophthalmic surgery. Perhaps in a subsequent edition blank pages for notes will be interleaved.

The book has no illustrations, and any instrument mentioned is referred to by its number in the maker's illustrated catalogue. The fullest value of the book will be realized only with possession of such catalogues; but, as the preface indicates, that of John Weiss at least is to be obtained for the asking.

The book will be very useful to the beginner in ophthalmic surgery, providing as it does a complete guide in the choice of equipment; to the theatre sister and eye nurse it will be indispensable; the established surgeon will find its possession well worth while, as within the limited scope of the work nothing has been omitted, and many useful hints are included.

Text Book of Surgery. Compiled by J. HOMANS, M.D.; Fifth Edition; 1940. Springfield: C. C. Thomas. London: Baillière, Tindall and Cox. Double crown 9mo, pp. 1269, with illustrations by W. C. Shepard. Price: $8.00 net.

HOMANS'S "Text Book of Surgery", a work which was first published in 1931, has reached its fifth edition. There can be little doubt that this work fully deserves the appreciation which, as a student's textbook of surgery, it has received. It is compiled from researches and writings of the members of the surgical department of the Harvard Medical School, and is profusely illustrated with simple, but most effective, line drawings by Willard T. Shepard. It is simply and clearly written and the matter is most comprehensive and well arranged. In the whole book there is little that is redundant, and nothing that is obsolete. The book has a special bibliographical index. A feature of the book, too, is an interesting historical sketch at the beginning of each chapter. The work has been kept continually up to date by the prompt publication of new editions.

Into this fifth edition many new items have been introduced, and much old matter has been revised. This has been accomplished by a process of interpolation without change of the pagination. The new matter includes amongst other things: new work on the vitamins; the use of sulphanilamide in hæmolytic streptococcal infections; the modern method of the preparation of the operating room and of the patient; new methods in the treatment of burns; advances in the treatment of fracture of the neck of the femur, of diseases of the thyreoid gland, and of cancer of the colon; and questions in regard to the operative treatment of appendicitis.

The comprehensiveness, the shrewd selection of matter, the up-to-dateness, the clearness with which it is written, make this work one of the most valuable textbooks on surgery at present available to the student or, indeed, to any practitioner who wishes to arm himself with accepted modern surgical knowledge.

Sclerosing Therapy. By F. C. YEOMANS; 1939. London: Baillière, Tindall and Cox. Imperial 8vo, pp. 337, with 185 illustrations. Price: 27s. net.

UNDER the title "Sclerosing Therapy", a symposium by four contributors is presented as representing the historical development and actual status of injection methods in the treatment of hernia, hydrocele, varicose veins and hæmorrhoids.

Arthur F. Bratrud discusses the anatomy of inguinal, femoral and umbilical herniæ in the usual text-book fashion. Because of the bad results obtained from the surgical treatment of hernia, as indicated by the recurrence rate of 2% to 18% in indirect inguinal hernia, the author claims that the method he describes is worth a trial. He admits that it will not replace the surgical repair of herniæ.

A useful chapter on the fitting of trusses should be commended. The absence of this subject from the modern surgical text-book is to be deplored. The fact that trusses are only occasionally employed is no reason for their entire neglect.

A very complete description of the experimental results obtained by various solutions injected, provides information of academic and, maybe, practical importance. Repeated injection is necessary; the aim of the treatment appears to be the production of a plastic exudate in the inguinal canal. It is admitted that the time required is longer than that for repair by open operation. The main advantage appears to be that the patient is ambulatory during treatment. Objections to the method are fairly stated. Acute coryza and eruptions may follow tannic acid injections. A very careful training in the technique appears to be necessary if disasters are to be avoided. A large collection of figures are presented to support the claim for the advantages of the injection method. These statistics, however, are not convincing when we note the fallacy in the statement "that the recurrence rate, following surgical repair with fascial transplants, is greater than repair without transplants". The enthusiasm of the author of this section is to be commended, but it is doubtful whether the injection method will ever supplant a carefully planned and skilfully executed surgical operation.

George F. Holt describes the injection treatment of hydrocele. Quinine hydrochloride is the fluid employed; two to four cubic centimetres of a 13·33% solution are injected after the sac has been emptied. The case for this form of treatment seems so conclusively proved that the author discusses the subject in thirteen pages. An analysis of a series of cases so treated would have been appreciated.

Harold J. Shelley contributes a well reasoned and illuminating article of 117 pages on the injection treatment of varicose veins. Contraindications for injections are discussed. The author favours quinine hydrochloride urethane, but he describes the many other substances used and mentions their peculiar properties. Ligation of the great saphenous vein is recommended in cases in which a positive reaction to the Trendelenburg test is obtained.

The treatment of varicose ulcers is discussed in detail. Complications due to injection of varicose veins are described at length in a useful chapter entitled "Failures of Injection Treatment: Their Causes and Prevention". That recanalization of thrombosed veins occurs is beyond any doubt. Nevertheless, time has shown that injection treatment of varicose veins is a useful but not the only means of dealing with this malady.

The editor describes the injection treatment of hæmorrhoids. This is the most disappointing contribution to the symposium. The injection of poisonous material into the centre of a distended pile, as shown in diagrams on page 313, invites nothing but condemnation. The dangers of this admittedly excellent form of treatment are

entirely omitted. The author's predilection for operation may perhaps explain his lukewarm advocacy of injection treatment, even in cases of first degree piles.

There is little in the book that cannot be found in the current text-books of surgery. On the other hand, there is much, particularly on the subject of injection for hernia, which is at present in the experimental stage; but the methods described are not to be recommended to the busy general surgeon.

Operative Orthopædics. By W. C. CAMPBELL, M.D.; 1939. St. Louis: C. V. Mosby. Australia: W. Ramsay. Imperial 8vo, pp. 1154, with 845 illustrations and four colour plates. Price: 75s. net.

"ALTHOUGH no attempt has been made to produce an atlas of orthopædic surgery, an effort has been made to describe those procedures which conform to mechanical and physiologic principles and will meet all requirements." Thus writes the author, Willis C. Campbell, of Memphis, United States of America, in the preface to this work, which without doubt fulfils his wish to meet "the current need for a comprehensive work on operative orthopædics".

There is little to criticize and much to praise in this very complete work, and the author is to be congratulated for compiling a volume which should become a standard reference in this special branch of surgery. In a few respects the magnitude of the task attempted has resulted in certain imperfections, so that descriptions of operative procedures which may be unfamiliar, are at times not given with that minute attention to small detail upon which their success so often depends. However, an extensive bibliography of references follows each separate section, so that original descriptions may be referred to if necessary. An attempt to introduce what may be described as an extremely sensible, but somewhat irritating, method of giving the position or range of movement of a limb or joint will certainly not meet with universal approval.

The general arrangement of the book leaves little to be desired, and repetition, which in a work of this type is inevitable to some extent, has been reduced to a minimum. Eight hundred and forty-five illustrations, including four colour plates, include reproductions of photographs and skiagrams, which, together with skilfully drawn schematic diagrams, clearly depict the various procedures described in the text. The opening chapters include a comprehensive survey of pathology and physiology pertaining to bones and joints, and excellent descriptions of the various splints and appliances in common use in orthopædic surgery. Plaster and theatre techniques are faithfully dealt with, and in particular the importance of "no-touch" technique and routine methods of "draping" in the theatre are properly stressed.

It is not possible, in a brief review, to deal with each section separately. Every type of operation that the orthopædic surgeon may be called upon to perform, will be found described under the appropriate heading. Many of the procedures described have not been performed in this country, and in all probability some at least will be omitted from subsequent editions. Sins of omission are amazingly few, possibly the most notable omission being Lambrinuidi's operation for the correction of claw foot; by it most encouraging results are being obtained in a condition in which hitherto disappointments have been many. Room should also be found in future editions to describe the late Naughton Dunn's method of treating ununited fractures of long bones by "living sub-cortical grafts"; and surely a short chapter on amputations would not be out of place in a work of this type.

Over two hundred pages are devoted to the operative treatment of fractures; in fact, it is difficult to name a fracture for which an operation is not described as a method of treatment. Unless attention is directed to the author's remark in the preface that "the majority [of orthopædic affections] are best treated by more conservative means", the reader is liable to gain the impression that fractures are treated by operative methods far more often than is usually the case.

One serious criticism can be made. In many instances the post-operative period of immobilization is quite inadequate. In our experience, few stabilized feet are sufficiently fused after eight weeks of plaster fixation to enable any form of brace to be worn with impunity. The same may be said of a sacro-iliac joint eight weeks after fusion, of an Albee graft in the spine after eight to ten weeks, and of a subtrochanteric osteotomy of the femur after the same brief period of immobilization. Many claw feet will recur if correction is maintained for only six weeks in plaster, and in many instances the author appears unduly optimistic as to when union in fractures may be expected to be firm.

Possibly the most interesting section is that dealing with the problem of arthroplasty. The author has done a great deal of original work on this subject, and has elaborated a technique of his own in performing arthroplasties of various joints which, in his hands at any rate, produces satisfactory results in weight-bearing joints. In the knee most surgeons prefer to aim at a fixed painless joint, rather than one with a limited range of movement which may not remain painless for long. The indications for and against arthroplasty in the joints of the lower limb are clearly set out and few will criticize them, though we doubt whether the results obtained are always worth while. Incidentally, few orthopædists in this country will agree that 30° (150° "new terminology") of flexion is the optimum position in which to arthrodese the knee joint.

These are all minor criticisms, but enough has been written to indicate that a most valuable contribution has been made to orthopædic literature. In short, this is a work which few orthopædists can afford to be without.

War Wounds and Air Raid Casualties. Articles republished from *The British Medical Journal*; 1939. London: H. K. Lewis and Company Limited. Demy 8vo, pp. 268. Price: 10s. 6d. net.

"WAR WOUNDS AND AIR RAID CASUALTIES" is a collection of articles republished in book form from *The British Medical Journal*. Most of the series were given as lectures at the British Postgraduate Medical School; others supplementing them were contributed by invitation. All of them are written by experts presenting the fruits of a wide experience gained during the Great War, or telling the lessons learned during the war in Spain.

The articles deal with war wounds of the various parts of the body in clear and concise form. They are necessarily short and to the point and, avoiding discussion on debatable aspects, give to the reader a sure and sound foundation for the management of these injuries. If one may choose amongst such excellent fare, it would be to describe as a classic Gordon Taylor's "Abdominal Injuries in Warfare". No room for doubt is left as to the course to be pursued in any of the multiplicity of lesions encountered in this class of casualty.

Today it is the duty of each one of us to be fully prepared to deal with these problems, either as a military medical officer or in a civil capacity in the case of air raid casualties. Those who have had an experience of this kind and those who have yet to meet it are here presented with a guiding hand which none can afford to reject.

The Surgery of Injury and Plastic Repair. By SAMUEL FOMON, Ph.D., M.D.; 1940. London: Baillière, Tindall and Cox. Imperial 8vo, pp. 1410, with 925 illustrations. Price: 94s. net.

THIS book well merits the term "work", consisting as it does of 1,390 pages all compiled by a single author. The author's object has been to correlate the advances during the past twenty years in the fields of traumatic and plastic surgery which have found expression in a vast number of contributions in English and foreign languages. Right well has he attained it. It is a long book, and, although the author states that clarity of expression and precision of detail have been given precedence over literary style, the perusal of every page has been a pleasure. The opening chapter is entitled "The Operation", and deals with the theatre and all the preparations and activities that a modern operation entails. The pre-operative management of the surgical patient is discussed with wisdom, and the author quotes in this regard: "It is unfortunate but true that the neglect of obtaining a careful history and a competent physical examination of pre-operative patients has been too often responsible for heartache in the surgeon and heartfailure in the patient." A hundred pages are devoted to the subject of tissue transplantation. The grafts and the manifold flaps employed in plastic surgery are considered, and a very interesting historical summary is included. With reference to the influence of the vitamins and the hormones on the healing of wounds the author concludes with a caution, which we share, that "it is difficult to estimate the clinical virtue of any one measure". To adapt a phrase of Anthony Hope in his play "My Lady Ursula", "where there is no action there is no virtue". The significance of the mental outlook of the patient is no modern discovery. Henri de Mondeville in the thirteenth century is cited by the author in support of that statement: "Encourage the patient with music of the sweet-stringed psaltery and with forged messages describing the death and confusion of his enemies, or his elevation to a bishopric if he be a churchman." The chapter on "Burns", although general in its scope, includes the

treatment of old unhealed burns and the plastic measures employed in the management of the contractures and deformities so apt to follow burns. In these days when surgeons are physiologically minded, a useful chapter reviewing the physiology of water, salt and acid base balance and its application to the treatment of hæmorrhage, acidosis, alkalosis and shock, is not out of place. In a work of this kind the reader is most likely to be tempted to refer at once to those chapters which deal with the plastic surgery of the head and face. Nor will he be disappointed. Before discussing the surgical measures applicable to each region, the author considers its anatomy. This is obviously of paramount importance in assessing an injury and devising a plan for its plastic repair. The plastic surgery of each region, for example, the nose, the eyelids, the auricle, the lips and the palate, is dealt with in great detail, and the wealth of illustrations serves to make clear operations which would otherwise be difficult to comprehend. A very full account is given of the more recent operations devised for the treatment of cleft palate and hare-lip. Many of those who read the book will be grateful to the author for the detailed account of Veau's operations, and for the numerous sketches which illustrate the successive steps. This is a fine book, and no one fortunate enough to possess it can fail to derive knowledge, pleasure and profit from it.

Proceedings of the Royal Australasian College of Surgeons.

THE GORDON CRAIG LIBRARY.

THE attention of Fellows is drawn to the following papers which have recently been fully translated from foreign literature:

"On the Understanding of Keratoconjunctivitis Sicca (Keratitis Filiformis in Hypofunction of the Lachrymal Glands)", by Henrik Sjögren, from *Acta Ophthalmologica* Supplementum ii, Copenhagen, 1933.

"Tobacco as a Cancer-Producing Agent", by Professor A. H. Roffo, from *Deutsche medizinische Wochenschrift*, Number 33, 1937.

"Wearing of the Gas Mask and Correction of Ametropia", by Cot, Moynier, Genaud and Robert, from *La presse médicale*, September 2, 1939.

"The So-Called Traumatic Thrombosis of the Axillary and Subclavicular Veins and its Consideration as a Result of Accident", by Dr. H. Zschau, from *Münchener medizinische Wochenschrift*, 1938.

"Operative Treatment of Acute Localized Phlebitis of the Lower Extremity", by Dr. I. Eisenklamm, from *Wiener klinische Wochenschrift*, Volume xlii, 1929.

"The Indications for Multiphasic Radical and Palliative Extirpation of Cancer of the Rectum", by Otto Goetze, from *Zentralblatt für Chirurgie*, Volume lxi, 1934.

"The Surgery of Cancer of the Rectum", by Otto Goetze, from *Archiv für klinische chirurgie*, Volume clxxx, 1934.

"Urological Complications with Carcinoma of the Rectum", by Otto Goetze, from *Zentralblatt für Chirurgie*, Volume lxiii, 1936.

"Classification of the Rectal Carcinoma for the Prognosis of the Permanent Cure and Operative Mortality: Approved Types of Operation", by Otto Goetze, from *Zentralblatt für chirurgie*, Volume lxvi, 1939.

"Hæmorrhoids or Cancer of the Rectum?" by Professor Otto Goetze, from *Monatsschrift für Krebsbekämpfung*, Volume vii, 1936.

"The Promotion of the Undisturbed Wound Healing with Abdominal and Sacral Opening and Resection of the Rectum by Means of a Water-Tight Fæcal Drainage", by Professor Otto Goetze, from *Zentralblatt für Chirurgie*, Volume lxv, 1938.

"Cure of Chyluria by Injections of Physiological Sodium Chloride into the Pelvis of the Kidney", by Dr. S. Takahasi and Dr. K. Ikeda, from *Zeitschrift für Urologie*, Volume xxxi, 1937.

"On Hereditary Choroido-Retinal Disease", by Dr. M. Schutzbach, from *Graefes Archiv für Ophthalmologie*, Volume cxxxviii, 1938.

Once again the Council wishes to remind Fellows that the following services are available in the Gordon Craig Library:

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2. Fellows resident in the Commonwealth of Australia will not be permitted to retain a book for more than one month, and Fellows resident in the Dominion of New Zealand for more than two months. Books not returned at the expiration of this time will be charged to Fellows.

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5. Photostatic copies of articles and illustrations appearing in textbooks, monographs, medical and surgical journals received at the College will be supplied to Fellows free of charge.

6. References will be supplied to Fellows of the College who are writing papers. Information concerning articles published on any particular subject, or by any particular author, will be supplied. Should the journal required not be available in the College library, facilities are available whereby Fellows may be informed whether the journal they require is available in Australia and, if so, at what library.

Fellows are invited to avail themselves of these services.

Notices.

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